7. COST-BENEFIT ANALYSIS

7.1 OVERVIEW

The cost-benefit analysis has been prepared to quantify the financial feasibility of a HELP system. The goal of the cost-benefit analysis is not to determine the benefits displayed during the demonstration evaluation period or to evaluate each vendors equipment specifically.

Throughout the demonstration, it has been identified that the potential of the equipment has not been realized due to a lack of utilization by the majority of weighstations, carriers and state personnel. Rather, therefore, the goal of this analysis is to determine if identifiable benefits are to be gained based on performance and accuracy of the observed equipment.

The analysis provides states with the necessary detail to determine the benefits applicable to their sites. In addition, the analysis presents quantitative benefits that will accrue to participating carriers. Finally, the analysis identifies the site specific improvements and the increased level of effort that are needed to bring the system to its potential.

The cost-benefit analysis has been developed considering the needs of federal, state and private organizations. The benefits that are explored in this analysis are those benefits previously defined in the HELP program, the Crescent Demonstration, and in other reports including:

* NCHRP 303, "Feasibility of a National Heavy Vehicle Monitoring System"; [3]
* "HELP Phase 1A Feasibility Study"; [4]
* "HELP Phase 1C Concept Development Study"; [5]
* NCHRP Special Report 239, "Hazardous Materials Shipment Information for Emergency Response"; [6] and
* "Findings from Five Years of Operating Oregon's Automated Woodburn Port-of-Entry". [7]

The data used in this cost-benefit analysis were derived from the on-site evaluation and testing, the participants' reported equipment costs, project surveys and previous research by federal, state and private organizations. The costs presented are based on average values rather than specific equipment costs, due to the variations in purchasing agreements, the time of purchase, existing equipment installed at sites, and the identified needs and specifications of participating states. The functional characteristics of the equipment are based on average values derived from the on-site evaluation. Information on the observed accuracy of specific equipment may be found in Chapter 5, Evaluation Results. The analysis is presented in three sections as follows:

* unit costs;

* benefits; and

* extrapolated benefits and associated costs of Crescent site configurations.

This approach allows participating and nonparticipating organizations an easy method of extracting specific information. Each section builds on the previous sections, making the analysis more complete, comprehensive and understandable. The first section presents the unit costs of equipment utilized in the demonstration project, as well as the potential costs that may be incurred following the Crescent Demonstration.

The second section defines and quantifies each of the identified benefits individually. A sensitivity analysis has been performed to illustrate the impact of variations in major factors of the benefits on the viability of the HELP concept.

The final section extrapolates the costs and benefits applicable to each of the Crescent site configurations and calculates the net benefit or net loss of each installation. This section provides a qualitative analysis of each of the configurations based on the testing and observations performed during the evaluation.

7.2 UNIT COSTS

The values presented in this section are based on reported costs of equipment. The values in Table 7-l are separated into regional, state and carrier costs and are presented below. High, medium and low costs for capital purchases, installation, operation and maintenance are presented. Detailed descriptions of each of the identified costs are provided to enable the reader to identify their scope and content. The regional costs identified include:

* regional computer system;

* Crescent state's central computer systems; and

* Crescent system management.

Participating state's site-specific costs include:

* WIM/AVC equipment;

* AVI infrastructure;

* Crescent state's computer terminals;

* weighstation computer systems;

Table 7-1 Equipment Unit Costs

Regional Costs:	Low	Medium	High
Capital and Installation:			
Regional Computer System		$78,387.00	
State Computer System	$60,800.00	$64,780.00	$74,433.00
Annual Operating Costs:			
Crescent Management		$850,000.00	$1,700,000.00
State Costs:			
Capital and Installation:			
WIM/AVC	$28,000.00	$40,000.00	$90,000.00
AVI	$7,000.00	$12,000.00	$50,000.00
State Computer Terminal		$3,030.00	
Lane Signal		$15,000.00	
Weighstation Computer System		$17,300.00	
Communications	$900.00	$2,000.00	$5,000.00
Annual Operating Costs:			
Equipment & Communications	$500.00	$7,000.00	$16,000.00
Annual Maintenance Costs:			
Equipment & Communications	$5,000.00	$20,000.00	$50,000.00
Carrier Costs:			
Capital and Installation:			
AVI Transponder		$200.00	$250.00
Computer Hardware/Software	$0.00	$3,000.00	$10,000.00
Communications	$0.00	$150.00	
Annual Operating Costs:			
Equipment & Communications	$0.00	$1,200.00	
User Fee		$1.00	
Annual Maintenance Costs:			
Equipment & Communications	$0.00		

* weighstation lane signals; and

* communications equipment.

Participating carriers' costs include:

* AVI transponder purchase;

* computer system hardware and software;

* communications needs; and

* bypass user costs.

Regional Costs

Regional costs are defined as the non-site specific expenses incurred by all the states participating in the Crescent Demonstration. These largely relate to the central database and processing facilities. The identified costs will be distributed equally to each of the Crescent sites in this analysis. These costs are divided into the following categories:

* capital and installation;

* annual operating costs; and

* annual maintenance costs.

Capital and Installation

Regional/State Computer Systems. The Crescent system's state and regional computer network consists of a regional computer system and three state computer systems. This network is used for the storage and retrieval of WIM, AVC and AVI information, and the production of various reports relating to the Crescent system.

The state computer systems are located in Santa Clara, California, and consist of independent systems for pairs of states. These state pairings are New Mexico and Texas, Oregon and Washington, and California and Arizona. Each state system is linked to the regional computer system which is also currently located in Santa Clara.

Table 7-2. Components of Regional Computer System

Quantity	Part Number	Description	Manufacturer
Santa Clara Regional Computer System			
1	SYS3640NY601	Computer system	Motorola
3	MVME22F4-2-6	8MB Memory	Motorola
1	TMOOOA	Monochrome terminal	Motorola
2	MVME332FXT-6	8 serial/l parallel	Motorola
1	M68N3TBV68M	Full function Unix	Motorola
1	MVME332FPA2-6	2 port parallel adapter	Motorola
2	MVME876F-6	600 MB SCSI HD	Motorola
1	MVME856F-6	2.3 GB tape drive	Motorola
1	MVME732F-6	Remote maint. facility	Motorola
1	MVME333FX25-6	X.25 comm. controller	Motorola
1	PT835	220/40 CPS printer	Texas Inst.
1	PT361 5	730/1 500 LPM printer	Motorola
2	CA23	Parallel printer cable	Motorola
1	CA14	RS232 cable	Motorola
1	M68N3TBVNE	Network svcs. ext.	Motorola
1	4GF30XE	lnformix 4GL dev sys	lnformix
1	ISM30XE	C-ISAM dev sys	tnformix
1	SQL30XE	SQL dev sys	l nformix
1	INT30XE	lnformix turbo	lnformix
1	ESQ30XE	ESQL-C dev sys	lnformix
		TOTAL	$78,387.00
New Mexico/Texas State Computer System			
1	SYS3640NYY601	Computer system	Motorola
3	MVME22F4-2-6	8MB Memory	Motorola
1	TMOOOA	Monochrome terminal	Motorola
2	MVME332FXT-6	8 serial/l parallel	Motorola
1	M68N3TBV68M	Full function Unix	Motorola

Table 7-2. Components of Regional Computer System (continued)

Quantitv	Part Number	Description	Manufacturer
1	NVNE876F-6	600 MB SCSI HD	Motorola
1	MVME856F-6	2.3 GB tape drive	Motorola
1	MVM E374F-6	Ethernet Ian controller	Motorola
1	MVME732F-6	Remote maint. facility	Motorola
1	MVME333FX25-6	X.25 comm. controller	Motorola
1	CA14	RS232 cable	Motorola
1	M6BN3TBVNE	Network svcs. ext.	Motorola
1	INT30XE	Informix turbo	Informix
1	4GL30RE	4GL Runtime	Informix
1	ISM30RE	C-ISAM Runtime	Informix
1	SQL30RE	SQL Runtime	Informix
1	ESQ030RE	ESQL-C Runtime	Informix
		TOTAL	$60,800.00

California/Arizona State Computer System

1	SYS3640NY601	Computer system	Motorola
3	MVME22F4-2-6	8MB Memory	Motorola
1	TMOOOA	Monochrome terminal	Motorola
1	MVME332FXT-6	8 serial/l parallel	Motorola
1	M68N3TBV68M	Full function Unix	Motorola
1	MVME876F-6	600MB SCSl HD	Motorola
1	MVME856F-6	2.3 GB tape drive	Motorola
1	MVME374F-6	Ethernet Ian controller	Motorola
1	MVME732F-6	Remote maint. facility	Motorola
1	MVME333FX25-6	X.25 comm. controller	Motorola
1	CA14	RS232 cable	Motorola
1	M68N3TBVNE	Network svcs. ext.	Motorola
1	lNT30XE	lnformix turbo	Informix
1	4GL30RE	4GL Runtime	Informix

Table 7-2. **Components of Regional Computer System (continued)**

Quantity	Part Number	Description	Manufacturer
1	ISM30RE	C-ISAM Runtime	Informix
1	SQL30RE	SQL Runtime	Informix
1	ESQ030RE	ESQL-C Runtime	Informix
		TOTAL	$64,780.00
Oregon/Washington State Computer System			
1	SYS3640NY601	Computer system	Motorola
3	MVME22F4-2-6	8MB Memory	Motorola
1	TMOOOA	Monochrome terminal	Motorola
2	MVME332FXT-6	8 serial/l parallel	Motorola
1	M68N3TBV68M	Full function Unix	Motorola
1	MVME876F-6	600MB SCSI HD	Motorola
1	MVME856F-6	2.3 GB tape drive	Motorola
1	MVME374F-6	Ethernet Ian controller	Motorola
1	MVME732F-6	Remote maint. facility	Motorola
1	MVME333FX25-6	X.25 comm. controller	Motorola
1	CA14	RS232 cable	Motorola
1	M68N3TBVNE	Network svcs. ext.	Motorola
1	INT30XE	Informix turbo	Informix
1	4GL30RE	4GL Runtime	Informix
1	ISM30RE	C-ISAM Runtime	Informix
1	SQL30RE	SQL Runtime	Informix
1	ESQ030RE	ESQL-C Runtime	Informix
		TOTAL	$74,433.00

The regional computer system cost $78,387 as displayed in Table 7-l. The lowest cost of the state computer systems was reported for the New Mexico/Texas system ($60,800), the medium cost for the California/Arizona system ($64,780) and the highest cost for the Oregon/Washington system ($74,433). The variations in cost that were reported are due to the number of sites and complexity of interface equipment for each of the states. Table 7-2 displays the components of each of the systems. The total Crescent regional and state computer network has a reported cost of $278,400.

A nnual Operating Costs

Crescent Management. The overall management of the Crescent system is provided by the Crescent Demonstration Operator (CDO). Within the Crescent Demonstration, this role has been undertaken by Lockheed Integrated Solutions Company The major services provided by the CDO include:

* maintenance of AVI equipment at all Crescent sites;
* maintenance, operation and updating of the Crescent database; and
* recruitment of carriers to be equipped with AVI transponders.

In addition, the CDO managed the overall Crescent system and acted as liaison with both states and carriers. The average annual operating cost incurred for the management of the Crescent system during the demonstration was $1.7 million.

It is anticipated that management costs will be significantly reduced after the demonstration due to the reduced efforts needed for system integration, training and coordination with states. This reduction in costs is predicted after the initial developmental and institutional problems have been overcome. An annual management cost of $850,000 will therefore be used in all analysis that projects Crescent costs into the future.

State Site-Specific Costs

The state equipment utilized in the Crescent Demonstration were purchased by the states and installed by both the states and the CDO. Descriptions of the costs of each type of Crescent equipment follows. These costs are divided into the following categories:

* capital and installation;
* annual operating costs; and
* annual maintenance costs.

Capital and Installation

WIM/AVC. The WIM and AVC equipment costs have been calculated and reported as a single unit cost per lane of equipment. These two equipment components are presented together for a number of reasons including:

* All Crescent sites that are installed with WIM equipment are also equipped with AVC equipment. Furthermore, in most configurations, the WIM and AVC equipment are manufactured by the same vendor.

* Both WIM and AVC work as a single unit for the benefits described in this chapter.

* Most states participating in the Crescent Demonstration purchased the WIM and AVC equipment together within a single work order or request for proposals (RFP).

The capital and installation costs presented in Table 7-1 include all pavement work, conduits, electrical connections, traffic cabinets, basic software interface (including sorting and signal control), and the WIM/AVC equipment. An average cost of $40,000 was not only the median reported costs, but the mode as well. The high cost of approximately $90,000 was reported at a site where the equipment was purchased prior to the Crescent Demonstration, when the technology, including integrated software, was more expensive. Yet, as will be discussed later in this chapter, this weighstation is one of the few sites utilizing the equipment on a daily basis. The low cost of $28,000 was reported for a large purchase order, with equipment supplied for approximately 20 mainline sites.

AVI. The AVI equipment capital and installation cost presented in Table 7-1 includes the AVI antennas, reader assembly/processor, lane kits, WIM interface, and conduits. As with the WIM/AVC equipment, the high cost of $50,000 was reported for a system that was installed prior to the Crescent. The AVI equipment installed at these sites is from Mark IV systems. This was purchased on behalf of the states by ADOT.

The average AVI cost per lane, as represented in Table 7-1, is $12,000. However, it was reported that the majority of that cost was for the reader system and that installation of an antenna in an additional cost about $2000.

State Computer Terminals. Separate from the Crescent computer systems housed in Santa Clara, California, each of the participating states received a terminal, printer and modem to retrieve data from the state and regional computer systems. The six terminals, which cost an average $3,030 each, are located at each of the participating states' capitals. Although each of the states received only a single terminal, any agency within the state could potentially poll the Crescent system with a computer, modem and the required state access code.

Weighstation Computer Systems. The weighstation computer systems are utilized by weighstation personnel to access and store WIM, AVC and AVI data. Similar equipment were provided to each of the participating weighstations with an average cost of $17,300. The components of the weighstation system are presented in Table 7-3.

Table 7-3. Components of State Computer System

CLIN	PART #	SERIAL #	DESCRIPTION	MFG	PRICE
3001	EXO-2808C-00	13900002	80386 Processor (25 MHZ)	Everex	3,129
3001B	MSN-00165-51		Everex Step 386 Owners Manual	Everex	
			Everex ESDI Controller	Everex	
3001C	MAN-00557-10		Everex ESDI Controller Manual	Everex	
3002	EIO-00882-00	WC531453	172MB Hard Disk Drive	Everex	1,259
3003	EVO-00678-00	BMQ-0045355	VGA Video Card	Everex	150
3004	MON-00400-0A	MNF-11101340	VGA Color Monitor	Everex	330
3004A	MAN-00500-10		Evervision Owners Manual	Everex	
3005	EIO-00830-07	477978PR	150 MB Streaming Tape SS	Everex	928
3007	77000035	D0001220	4 Port RS232C Card PC/4e	Digiboard	499
3007	76000008		Octopus Cable for Digiboard	Digiboard	42
3008	PTSES1121A	60P0103631Y	Printer, 24 Pin Dot Matrix	Alps	575
3008A	425-100299-00		Manual, Allegro Printer Users for 500XT	Alps	
3009	5001	859518	Terminal, Monochrome	Falco	561
3009	5001	859524	Terminal, Monochrome	Falco	561
3009A	210061-00		Falco Quick Setup Guide for Terminal	Falco	
3009A	210061-00		Falco Quick Setup Guide for Terminal	Falco	
3010	PCL-725	9104143	PC Lab Card	PC Lab	290
3011	7899M		Vertical CPU Stand	Devoke	38
3012	PC-320	31385	Retix WAN Coprocessor Card	Retix	1,185
	89000657	6206	UDS Modem	UDS	834
	N/A	N/A	UDS Modem Manual	UDS	
6002	26950		Codex Modem, 3380, 19.2 S.A.	Codex	2,995
7001	300-1		Cable, 15 ft. RS232c for Modem	Inmac	50
7002	NMF-2250		Cable, 50 ft. for Workstation	Cable Conn	55
7002	NMF-2250		Cable, 50 ft. for Workstation	Cable Conn	55
7003	ICP2325		Cable, 25 ft. for Printer (Parallel)	Cable Conn	150
7004	1977-3		Cable, KYBD Extension	Inmac	19
7005	797		Cable, Monitor Extension	Inmac	16
	1966		Cable, Null Modem for AVI	Inmac	10
8007	0S20024	678389	Interactive Unix Full Function OPS	Interactive	505

Table 7-3. Components of State Computer System (continued)

CLIN	PART #	SERIAL #	DESCRIPTION	MFG	PRICE
	MU30011	5947	Unix Operating System (Multi-User)	Interactive	500
	TC00004	692444	Unix Interactive TCP/IP	Interactive	261
8008	102-05011-009033-2	INF#R178352	4GL Runtime	Informix	530
8016	102-041111-009034	LEX#F178555	SQL Runtime	Informix	370
	102-07201-009034	LEX#F178559	Standard Engine Runtime	Informix	720
8017	WT-325		V1.0.00 w/Com Fac V1.3	Retix	575
	8227		Power Surge Protector	Inmac	15
	ME1.15KVA	ME1.1K08651	UPS (Unprotected Power Surge)	Best	
	BSK0045		Software for UPS	Best	
				TOTAL	17,208

Lane Signal. The lane signal equipment is used by weighstations for in-station bypass applications. Signals currently in use are interfaced with either the WIM, or the WIM and AVI together. Based on the trucks ability to meet the weight-only or weight and credentials criteria established by the weighstation, the lane signal will display either an X or an arrow to direct vehicles to the bypass or scale lane. A signal system similar to the arrow-and-X directional signal displays a light on a message board which notifies the truck to proceed to the scales or to the bypass lane. Both signal systems' equipment consist of the lane signal mast pole, directional or lighted message board signal, connection and conduits. The reported cost of a weighstation lane signal is $15,000.

Communications. Communications are those costs in addition to the standard equipment used to transfer data from the WIM, AVC and AVI to the main Crescent system. Primarily incurred at remote WIM and AVI sites, these costs include purchase and installation of dedicated phone lines, conduits, modems and service charges for phone connection. The average cost of communications connection is $2,000 at these sites.

Annual Operating Costs

Equipment and Communications. The primary operating costs identified by the participating states were electric power for the WIM, AVC, AVl and computers, and the telephone charges for communications with remote sites. Of the operating costs reported by the states, the telephone/communication charges were identified as contributing the largest percentage, with a dedicated phone line expense of as high as $1,200 a month. The medium operating cost displayed in Table 7-1 represents the charges associated with an average mainline installation with dial-up phone connection, which is not connected at all times. The low operating cost of $500 represents the average charges associated with a weighstation installation.

Annual Maintenance Costs

Equipment and Communications. The average reported maintenance cost for both mainline and weighstation installations was $20,000 which was reported as including calibration and initial system debugging. As stated previously, these maintenance charges do not include AVI equipment, which is maintained by the CDO. Although most of the site specific, initial problems are resolved, the average annual maintenance cost of $20,000 will be utilized throughout the analysis due to the necessary increase in system calibration frequency.

Carrier Costs

These costs are divided into the following categories:

* capital and installation;

* annual operating costs; and

* annual maintenance costs.

Capital and Installation Costs

AVI Transponders. The medium cost for AVI transponders of $200, displayed in Table 7-1, represents the Type II transponder utilized by all participating carriers during the demonstration. The Type II transponder is a read-only transponder with part variable code. This unit allows information to be transferred from the AVI transponder to the AVI reader in the field, but does not allow information to be received by the transponder. The high cost displayed in Table 7-l represents a Type III, a full read/write transponder which would allow two-way communications between the AVI reader and the AVI transponder. Type III transponders were reported as including cab display terminals within the associated cost. The display terminals would allow trucks to completely bypass weighstations. The majority of AVI-equipped trucks did not have display terminals during the demonstration. These costs represent estimates provided by the CDO.

Computer Hardware/Software. Computer systems were not supplied to any of the carriers participating in the Crescent Demonstration. As presented in the analysis, a carrier could derive the benefit of in-station bypass without the need for a computer. The low cost of $0 displayed in Table 7-l reflects this scenario. The medium cost of $2,000 represents the carrier's expense associated with purchasing a basic computer terminal, modem and printer. This equipment would allow the carrier to poll and print truck reports from the Crescent database. The high cost of $10,000 represents an estimate of the expense associated with the purchase of custom software that could develop mapping programs to identify fleet locations or allow carriers to compute tax information and reduce costs associated with state audits.

Communications. Connection of the carrier's computer to the Crescent system through an existing telephone line incurs no expense providing *a* modem is already available. This is shown as the low cost of $0 for carrier communications in Table 7-l. An average/medium cost of $150 for communications represents the installation of a separate telephone line for the computer. This cost would be typical for a carrier that chooses to have a separate line for the computer system for fleet tracking.

A nnual Operating Costs

Equipment and Communications. The annual operating cost displayed in Table 7-l represents the expense associated with telephone charges. During the Crescent Demonstration the CDO provided a toll-free 800 number for carriers to poll the database without charge. This represents the low cost of $0 to the carrier. It has not yet been negotiated whether this service will continue after the demonstration. The medium and high costs displayed in the table therefore represent estimates of operating costs to carriers. The medium cost of $1,200 represents the average expense associated with polling the Crescent database on a regular basis.

Bypass User Fee. During the Crescent demonstration, carriers were not required to pay for any of the potential benefits gained. A carrier user fee has been proposed, by the CDO, for the

benefit of mainline bypassing. It is assumed in this analysis that in-station bypassing will not assess this users fee to carriers. The user fee is estimated at $1 per bypassed weighstation. This estimated value will be utilized throughout the analysis when estimating the cost to carriers of mainline bypass.

Annual Maintenance Costs

Equipment and Communications. There are no projected equipment maintenance costs for carriers. AVI transponders are proposed to be maintained by the CDO after the demonstration.

Benefits

This section of the cost-benefit analysis presents benefits which have been identified as realistic, based on the equipment evaluations conducted during the demonstration. However, as stated previously, the majority of Crescent installations were not being utilized to their full capabilities during the demonstration. Therefore, this section not only quantifies each benefit, but also presents the assumptions and level of effort required. To facilitate this analysis, each of the identified benefits will be described and presented in detail.

By presenting each benefit individually in this section, states and carriers can examine the applicability of the benefit to the goals and objectives established for their installations and equipment. Following a benefit's description there is a list of assumptions needed to derive the benefit's value. Finally, a process of quantifying the benefit is presented.

The state and carrier benefits are separated in this section to provide quick examination of each group's benefits. State benefits are further divided into weighstation benefits and mainline benefits. State mainline benefits include:

* data collection;
* hazardous material tracking;
* improved collection of weight/distance taxes; and
* mainline weight enforcement.

State weighstation benefits include:

* reduced operating costs;
* automated credentials inspections; and
* automated safety inspection scheduling.

Carrier Benefits include:

* time savings at weighstations;

* one-stop shopping; and

* fleet management.

State mainline benefits

Data collection

Description/Need. Both federal and state agencies require traffic volume, weight and classification data. NCHRP Report 303 [3] identified four areas where federal and state agencies utilize these data including:

* highway planning;

* pavement and bridge design;

* needs studies, cost allocation studies, and other policy analyses; and

* highway research.

In order for traffic data to be useful to transportation agencies, data consistency as well as data continuity is required. Data consistency is defined as the receiving of data in the same or similar formats. Currently, federal transportation agencies receive traffic data in many different formats from the states. This situation increases processing time by requiring federal agencies to resort data in an attempt to ensure consistency from all sources.

Data continuity is defined as providing all of the data needed. While highway planning only requires traffic volume and classification data, pavement and bridge design, cost allocation studies and highway research need traffic weight data. Prior to the implementation of WIM and AVC, state agencies collected traffic volume and classification data through manual counts or automatic traffic recording networks (ATR). Vehicle weight data were obtained through spot weight inspections on the highway, using portable scales, or at weighstations. It has been reported that spot inspections are labor intensive and weighstation data do not accurately portray the true characteristics of vehicle weights on the highway [8].

The HELP WIM and AVC equipment can provide the data consistency and continuity required by state and federal transportation agencies. HELP reports provide data in usable formats for each state. Any additional format required is easily obtained because the raw data are automatically stored in a computer file. Therefore, there is no need to manually transcribe field data into the computer system. The mainline weight data now obtainable from WIM and AVC

has demonstrated the potential to eliminate the guesswork and simulation techniques previously used.

Assumptions. The following assumptions were made to quantify this benefit:

* The volume of data collected from ten, 48-hour data collection sessions is beneficial to transportation engineers and planners.

* Data collection personnel's average salary, including benefits, is $30,000 annually (sensitivity analyses are performed for salaries of $20,000 and $40,000).

* Two hours of processing time are required for every hour of data collection (sensitivity analyses are performed for one and three hours).

Quantification of Benefit. The method used to derive the value of this benefit is the comparison of currently obtainable WIM and AVC axle weight data with one of the previous methods of collecting these data: spot weight inspections on the highway. The volume of data collected is based on the Traffic Monitoring Guide (TMG) [9] recommendations for collection of traffic weight data using WIM The TMG recommends that weight data be collected with a precision of 95- 10. 95-10 is a short form for the criterion of "estimating equivalent single axle loads (ESALs) for 3S2s on the Interstate System or on other roads as a whole within plus or minus 10 percent of the true value with 95 percent confidence" according to the TMG. The TMG also states that this criterion can be accomplished by using WIM and AVC equipment for ten, 48-hour data collection sessions per year. As discussed in Chapter 5, the average percentage difference of WIM weights with true weights was found to be 9.8%, which is within the TMG specification. With regular calibration, the WIM/AVC system could bring this difference to within 2 percent of the true value (based on the average absolute difference reported in Chapter 5).

In order to collect the recommended weight data using previous methods would require two state personnel using a portable scale for ten, 96-hour data collection sessions per year. This is an extremely conservative estimate that assumes state personnel are able to weigh one truck for every two vehicles that pass over the WIM. In addition, manual data collection requires data transcription as well as data processing time. Sensitivity analyses are performed using estimates of one, two and three hours of data processing for every hour of data collection. Sensitivity analyses are also performed on the average salary of data collection personnel. Hourly rates for annual salaries of $20,000, $30,000 and $40,000 per year are also provided in the sensitivity analyses. Salaries are based on reported average state employee wages, including benefits. High, medium and low values for the estimated cost of manual data collection are presented in Table 7-4. As presented in the table, the medium cost of manual traffic weight data collection is $55,373 per site.

Table 7-4 Estimated Cost of Manual Data Collection

(sensitivity analysis for wage rates:$20k,$30k,$40k)

	Sessions	Personnel	Hours per Session	Processing Time (hrs)	Wage Rate ($/hr)	Total Cost
Low	10	2	96	2	$10	$36,941
Medium	10	2	96	2	$1,442	$55,373
High	10	2	96	2	$1,923	$73,843

(sensitivity analysis for processing time: 1,2,3 hrs)

	Sessions	Personnel	Hours per Session	Processing Time (hrs)	Wage Rate ($/hr)	Total Cost
Low	10	2	96	1	$14	$41,530
Medium	10	2	96	2	$14	$55,373
High	10	2	96	3	$14	$69,216

Hazardous Material Tracking

Description/Need. According to TRB Special Report 239 [6] in approximately 25 percent of consequential hazardous material accidents on the highway, emergency services personnel could not obtain, or experienced significant delay in obtaining, necessary information on the contents of haz-mat trucks.

Currently, emergency response personnel obtain the information on a haz-mat vehicle's contents through placards, shipping papers and markings on the vehicles. Unfortunately, in many cases, emergency services personnel found the information to be not readily available or unobtainable from these sources, TRB Special Report 239 identified automated information systems as a key element in alleviating these problems and specifically identified the HELP system as having potential to act in this capacity. The HELP AVI system identifies vehicles equipped with AVI transponders at both mainline and weighstation installations. This system offers the potential to allow emergency response personnel to quickly determine the contents of a hazardous material carrier's shipment through communications with Crescent sites or directly with the Crescent database.

Assumptions. The following assumptions were made to quantify this benefit:

* This benefit requires the deployment of a large network of AVI sites to have a significant effect on emergency services personnel's information acquisition procedures It is assumed that benefits would begin to accrue after an initial network of approximately 120 sites

* Information problems are reduced by 50% after an initial network of 120 sites is installed in the Crescent corridor. This percentage is assumed to increase by 5% each year (with the addition of 20 new sites).

* The annual cost of hazardous material accidents is assumed to increase by 5% annually.

* Conservative estimates of 10, 15 and 20% are made for the percentage of hazardous material accident costs attributable to information problems.

* This benefit requires all hazardous material carriers operating in the Crescent corridor to be equipped with AVI transponders.

Quantification of Benefit. TRB Special Report 239 suggested that the potential benefit of an automated information system could be quantified by evaluating the costs relating to emergency services personnel's difficulties in obtaining necessary information at hazardous material accident sites. Seven areas were identified by the report as containing the majority of the costs associated with haz-mat accidents. These areas include:

* avoidable injuries;

* property losses;

* traffic delays;

* evacuations;

* inefficient use of response resources;

* environmental damages; and

* spill cleanup costs.

Of these seven areas, only four were quantified within the report. Table 7-5 presents the reported average yearly costs associated with hazardous material accidents in each of these four areas. Sensitivity analyses are performed on the percentage of these costs that are directly attributable to emergency response personnel's difficulty in obtaining information on the haz-mat contents. Values of 10, 15 and 20 percent are utilized. These conservative estimates are based on the reports findings that many damages are probably due to emergency personnel "acting cautiously when confronted with missing or unreliable data," as well as the report's estimate that in approximately 25 percent of consequential haz-mat accidents, emergency personnel could not obtain information on the type of hazardous material involved.

Table 7-6 displays the average value of this benefit per site, over a 20-year period, based on the medium estimate of 15 percent reduction in haz-mat accident costs, as determined in the sensitivity analysis performed in Table 7-5. Table 7-6 presents an estimate that hazardous material accident costs, associated with emergency personnel's difficulties in obtaining information, will be reduced by 50 percent when 120 Crescent installations are operational in the corridor. As more sites are added to the system and emergency response personnel become accustomed to utilizing the Crescent database, this percentage is assumed to increase by 5 percent each year.

Improved Collection of Mileage-Based Tares

Description/Need. At present, ten U.S. states have third structure taxes. These are taxes which seek to establish a method of assigning highway cost responsibility to each user. They include weight-distance tax, ton-mile tax and axle-mile tax. Of the six states evaluated in the Crescent Demonstration, three states currently collect some form of weight-distance taxes. These states are Oregon, New Mexico and Arizona. This benefit is therefore applicable to these, and future HELP states, which collect weight-distance taxes.

The Crescent system would derive this benefit by allowing states to better monitor truck records through comparison with AVI records. One of the participating states has estimated the percentage of tax evasion and the value of reduced tax evasion. The values derived by this state are the basis for this benefit [10].

Table 7-5 ESTIMATED YEARLY COSTS OF HAZARDOUS MATERIAL ACCIDENTS

	Annual Accident Costs ($)	Proportion of Costs due to Information Difficiencies (%)	Costs relating to Information Difficiencies ($)
Property Losses	50,000,000	10	5,000,000
		15	7,500,000
		20	10,000,000
Highway Closures	20,000,000	10	2,000,000
		15	3,000,000
		20	4,000,000
Evacuations	25,000,000	10	2,500,000
		15	3,750,000
		20	5.000,000
Inefficient use of response resources	125,000,000	10	12,500,000
		15	18,750,000
		20	25,000,000
Total Cost		10	22,000,000
		15	33,000,000
		20	44,000,000

Table 7-6 - ESTIMATED VALUE OF REDUCED HAZARDOUS MATERIAL ACCIDENT COSTS OVER A 20 YEAR PERIOD

Year	Number of HELP Sites	Total Cost of due to Information Difficiencies ($)	Average Cost per state ($)	Proportion of Costs Reduced by HELP system (%)	State Savings due to Reduced Hazardous Material Accidents ($)	Savings per HELP site ($)
1	-	33,000,000	660,000	-	-	-
2	-	34,650,000	693,000	-	-	-
3	120	36,382,500	727,650	25	181,913	9,096
4	140	38,201,625	764,033	30	229,210	9,823
5	160	40,111,706	802,234	35	280,782	10,529
6	180	42,117,292	842,346	40	336,938	11,231
7	200	44,223,156	884,463	45	398,008	11,940
8	220	46,434,314	928,686	50	464,343	12,664
9	240	48,756,030	975,121	55	536,316	13,408
10	260	51,193,831	1,023,877	60	614,326	14,177
11	280	53,753,523	1,075,070	65	698,796	14,974
12	300	56,441,199	1,128,824	70	790,177	15,804
13	320	59,263,259	1,185,265	75	888,949	16,668
14	340	62,226,422	1,244,528	80	995,623	17,570
15	360	65,337,743	1,306,755	85	1,110,742	18,512
16	380	68,604,630	1,372,093	90	1,234,883	19,496
17	400	72,034,861	1,440,697	95	1,368,662	20,530
18	420	75,636,604	1,512,732	100	1,512,732	21,610
19	440	79,418,435	1,588,369	100	1,588,369	21,660
20	460	83,389,356	1,667,787	100	1,667,787	21,754
Total					14,898,556	281,448
Average Savings Per Year					744,928	14,072
Net Present Value					4,144,424	92,745

Assumptions. The following assumptions were made to quantify this benefit:

* The reduction in tax evasion is assumed to be proportional to the percentage of AVI equipped trucks. Sensitivity analyses are performed on the percentage reduction in tax evasion utilizing values of 0.03, 0.05 and 0.1 percent.

* Benefits will begin to accrue after IO percent of the heavy vehicle population is equipped with AVI transponders.

* Weight-distance tax revenues are assumed to be $220 million in an initial year and increase by 2.4 percent annually thereafter. This assumption was utilized by Oregon DOT when estimating the cost of tax evasion.

* The average annual cost of tax evasion is proportional to the total weight-distance tax revenue assessed by the state. This is assumed to be 0.9 percent. This assumption was utilized by Oregon DOT when estimating the cost of tax evasion.

Quantification of Benefit. The value of this benefit is based on Oregon's estimated cost of weight-distance tax evasion as reported in "Strategic Plan for IVHS /CVO in Oregon" [10] and assumptions made in NCHRP Report 303. According to Oregon's estimate, $2,000,000 in additional tax revenue will be collected for each one percent reduction in tax evasion. Tables 7-7, 7-8 and 7-9 present the estimated benefit to a state due to reduced tax evasion, utilizing estimated reductions in tax evasion of 0.03, 0.05 and 0.1 percent, respectively.

Mainline Weight Enforcement

Description/Need. Reduction in premature deterioration of highways and bridges has been identified as potentially one of the most beneficial areas of the HELP system. A report produced by the General Accounting Office (GAO) in July 1979 [11] concluded that truck overloads were responsible for some $562 million of premature deterioration each year on the interstate highway system alone.

A more recent study by Oregon DOT [10] concluded the damage to state highways to be $20 million annually. The damage caused by truck overloads is not directly proportional to a truck's weight. A recent ITE Journal article [12] stated, "pavement damage due to the number and weights of axle loads can be expressed as a function of the number of axles which use a road (k) times the axle load to the 4.5 power:

$$\text{Damage} = \mathbf{k} * (\text{axle load})^{4.5}$$

According to the equation, doubling the axle load does not double the damage. It increases it by almost 23 times."

Table 7-7 - ESTIMATED VALUE OF REDUCED TAX EVASION OVER 20 YEAR PERIOD
(low case: .03 percent reduction in tax evasion)

Year	Total Number of HELP Sites	Number of HELP sites per state	Proportion of AVI equipped trucks (%)	Weight Distance Taxes per State ($M)	Weight Distance Tax Evasion ($M)	Reduction in Tax Evasion (%)	Reduced Tax Evasion ($)	Savings per HELP site ($)
1	-	-	3	220.00	1.98	-	-	-
2	-	-	6	225.28	2.03	-	-	-
3	120	20	10	230.69	2.08	0 03	62,285	3,114
4	140	23	15	236.22	2.13	0 05	95,670	4,100
5	160	27	20	241.89	2.18	0 06	130,622	4,898
6	180	30	25	247 70	2.23	0 08	167,196	5,573
7	200	33	30	253 64	2.28	0 09	205,451	6,164
8	220	37	35	259.73	2.34	0 11	245,445	6,694
9	240	40	40	265.96	2 39	0 12	287,241	7,181
10	260	43	45	272.35	2.45	0 14	330,901	7,636
11	280	47	50	278.88	2.51	0 15	376,492	8,068
12	300	50	51	285.58	2.57	0 15	393,239	7,865
13	320	53	52	292 43	2 63	0 16	410,572	7,698
14	340	57	53	299 45	2 70	0 16	428,511	7,562
15	360	60	54	306.64	2.76	0 16	447,074	7,451
16	380	63	55	313 99	2 83	0 17	466,282	7,362
17	400	67	56	321.53	2 89	0 17	486,154	7,292
18	420	70	57	329 25	2 96	0 17	506,711	7,239
19	440	73	58	337 15	3 03	0 17	527,975	7,200
20	460	77	59	345.24	3 11	0 18	549,968	7,173
Total							6,117,790	120,271
Average Savings Per Year							305,890	6,014
Net Present Value							1,809,873	41,532

Table 7-8 - ESTIMATED VALUE OF REDUCED TAX EVASION OVER 20 YEAR PERIOD
(medium case: .05 percent reduction in tax evasion)

Year	Total Number of HELP Sites	Number of HELP sites per state	Proportion of AVI equipped trucks (%)	Weight Distance Taxes per State ($M)	Weight Distance Tax Evasion ($M)	Reduction in Tax Evasion (%)	Reduced Tax Evasion ($)	Savings per HELP site ($)
1	-	-	3	220.00	1.98	-	-	-
2	-	-	6	225.28	2.03	-	-	-
3	120	20	10	230.69	2.08	0 05	103,809	5,190
4	140	23	15	236.22	2.13	0 08	159,451	6,834
5	160	27	20	241 89	2 18	0 10	217,703	8,164
6	180	30	25	247 70	2.23	0 13	278,660	9,289
7	200	33	30	253 64	2.28	0 15	342,418	10,273
8	220	37	35	259 73	2.34	0 18	409,075	11,157
9	240	40	40	265.96	2.39	0.20	478,735	11,968
10	260	43	45	272.35	2.45	0.23	551,502	12,727
11	280	47	50	278 88	2.51	0.25	627,487	13,446
12	300	50	51	285.58	2 57	0.26	655,398	13,108
13	320	53	52	292 43	2.63	0.26	684,287	12,830
14	340	57	53	299 45	2.70	0.27	714,185	12,603
15	360	60	54	306 64	2 76	0 27	745,124	12,419
16	380	63	55	313 99	2 83	0 28	777,136	12,271
17	400	67	56	321 53	2.89	0 28	810,257	12,154
18	420	70	57	329 25	2 96	0 29	844,519	12,065
19	440	73	58	337 15	3 03	0.29	879,959	11,999
20	460	77	59	345.24	3.11	0 30	916,614	11,956
Total							10,196,317	200,452
Average Savings Per Year							509,816	10,023
Net Present Value							3,016,456	69,220

Table 7-9 - ESTIMATED VALUE OF REDUCED TAX EVASION OVER 20 YEAR PERIOD
(high case: .1 percent reduction in tax evasion)

Year	Total Number of HELP Sites	Number of HELP sites per state	Proportion of AVI equipped trucks (%)	Weight Distance Taxes per State ($M)	Weight Distance Tax Evasion ($M)	Reduction in Tax Evasion (%)	Reduced Tax Evasion ($)	Savings per HELP site ($)
1	-	-	3	220 00	1.98	-	-	-
2	-	-	6	225.28	2.03	-	-	-
3	120	20	10	230.69	2 08	0 10	207,618	10,381
4	140	23	15	236.22	2 13	0 15	318,901	13,667
5	160	27	20	241.89	2.18	0.20	435,407	16,328
6	180	30	25	247.70	2.23	0.25	557,320	18,577
7	200	33	30	253.64	2.28	0 30	684,835	20,545
8	220	37	35	259 73	2.34	0.35	818,150	22,313
9	240	40	40	265.96	2.39	0.40	957,469	23,937
10	260	43	45	272.35	2.45	0.45	1,103,005	25,454
11	280	47	50	278.88	2.51	0.50	1,254,974	26,892
12	300	50	51	285.58	2.57	0 51	1,310,795	26,216
13	320	53	52	292.43	2.63	0.52	1,368,573	25,661
14	340	57	53	299 45	2.70	0.53	1,428,369	25,207
15	360	60	54	306 64	2.76	0 54	1,490,247	24,837
16	380	63	55	313.99	2.83	0 55	1,554,273	24,541
17	400	67	56	321 53	2.89	0 56	1,620,513	24,308
18	420	70	57	329.25	2.96	0 57	1,689,038	24,129
19	440	73	58	337 15	3.03	0 58	1,759,918	23,999
20	460	77	59	345.24	3.11	0 59	1,833,228	23,912
Total							20,392,634	400,904
Average Savings Per Year							1,019,632	20,045
Net Present Value							6,032,911	138,440

While weight enforcement at weighstations will be improved through the use of HELP equipment, the percentage of overweight vehicles is not expected to drop significantly. This is due to violating carriers knowledge of weighstation and POE activities. According to a report produced by ADOT [8], which examined vehicle weights using mainline WIM, the percentage of illegal loads on the evaluated highway averaged 35 percent during times in which a nearby POE was open and rose rapidly to an average 65 percent when the POE was closed. This benefit examines the potential of deploying weight enforcement personnel at random WIM locations for the inspection of vehicle weights on the mainline.

Assumptions. The following assumptions were made to quantify this benefit:

* This benefit assumes that overweight travel will be discouraged due to the presence of WIM and an irregular schedule of weight enforcement.

* A percentage reduction in overweight travel of 0.5 percent each year will be utilized with sensitivity analyses performed on increases of **0.25** and 1 percent.

* Highway damage from overloads is estimated to be $20 million in the first year and increases by 2.4 percent annually. This assumption is based on Oregon DOT's estimates of road damage from overloads in that state [10].

Quantification of Benefit. The benefit of mainline weight enforcement is quantified by estimating the percent reduction in weight overloads and the associated savings from reduced pavement damage. Sensitivity analyses are performed on the percentage reduction in overloads. The results of these analyses are presented in Tables 7-10, 7-11 and 7-12.

State **Weighstation Benefits**

State weighstation benefits include:

* Reduced operating costs;

* Automated credentials inspections; and

* Automated safety inspection scheduling.

Table 7-10 - ESTIMATED SAVINGS FROM REDUCED ROAD DAMAGE OVER A 20 YEAR PERIOD
(low case: .25 percent reduction in overloads)

Year	Total Number of HELP Sites	Number of HELP sites per state	Road Damage from Overloads **($M)**	Reduction In Overloads (%)	1 otal Reduced Road Damage ($M)	Savings per HELP site ($)
1	80	13	20.00	0.25	0.05	3,750
2	100	17	20.48	0.50	0.10	6,144
3	120	20	20.97	0.75	0.16	7,864
4	140	23	21.47	1 .00	0.21	9,204
5	160	27	21.99	1.25	0.27	10,308
6	180	30	22.52	1.50	0.34	11,259
7	200	33	23.06	1.75	0.40	12,106
8	220	37	23.61	2.00	0.47	12,879
9	240	40	24.18	2.25	0.54	13,600
10	260	43	24.76	2.50	0.62	14,284
11	280	47	25.35	2.75	0.70	14,940
12	300	50	25.96	3.00	0.78	15,577
13	320	53	26.58	3.25	0.86	16,200
14	340	57	27.22	3.50	0.95	16,814
15	360	60	27.88	3.75	1.05	17,422
16	380	63	28.54	4.00	1.14	18,028
17	400	67	29.23	4.25	1.24	18,634
18	420	70	29.93	4.50	1.35	19,242
19	440	73	30.65	4.75	1.46	19,853
20	460	77	31.39	5.00	1.57	20,469
Total					14.12	268,683
Average Savings Per Year					0.71	13,434
Net Present Value					4.101	97,783

Table 7-11 - ESTIMATED SAVINGS FROM REDUCED ROAD DAMAGE OVER A 20 YEAR PERIOD
(medium case: .5 percent reduction in overloads)

Year	Total Number of HELP Sites	Number of HELP sites per state	Road Damage from Overloads ($M)	Reduction in Overloads (%)	Total Reduced Road Damage ($M)	Savings per HELP site ($)
1	80	13	20.00	0.25	0.05	3,750
2	100	17	20.48	0.50	0.10	6,144
3	120	20	20.97	1.00	0.21	10,486
4	140	23	21.47	1.50	0.32	13,805
5	160	27	21.99	2.00	0.44	16,493
6	180	30	22.52	2.50	0.56	18,765
7	200	33	23.06	3.00	0.69	20,753
8	220	37	23.61	3.50	0.83	22,539
9	240	40	24.18	4.00	0.97	24,179
10	260	43	24.76	4.50	1.11	25,711
11	280	47	25.35	5.00	1.27	27,164
12	300	50	25.96	5.50	1.43	28,558
13	320	53	26.58	6.00	1.60	29,908
14	340	57	27.22	6.50	1.77	31,226
15	360	60	27.88	7.00	1.95	32,522
16	380	63	28.54	7.50	2.14	33,803
17	400	67	29.23	8.00	2.34	35,076
18	420	70	29.93	8.50	2.54	36,345
19	440	73	30.65	9.00	2.76	37,616
20	460	77	31.39	9.50	2.98	38,891
Total					25.91	483,838
Average Savings Per Year					1.30	24,192
Net Present Value					7.25	164,014

Table 7-12 - ESTIMATED SAVINGS FROM REDUCED ROAD DAMAGE OVER A 20 YEAR PERIOD
(high case: 1percent reduction in overloads)

Year	Total Number of HELP Sites	Number of HELP sites per state	Road Damage from Overloads ($M)	Reduction in Overloads (%)	Total Reduced Road Damage ($M)	Savings per HELP site ($)
1	80	13	20.00	0.25	0.05	3,750
2	100	17	20.48	0.50	0.10	6,144
3	120	20	20.97	1.00	0.21	10,486
4	140	23	21.47	2.00	0.43	18,407
5	160	27	21.99	3.00	0.66	24,739
6	180	30	22.52	4.00	0.90	30,024
7	200	33	23.06	5.00	1.15	34,588
8	220	37	23.61	6.00	1.42	38,638
9	240	40	24.18	7.00	1.69	42,312
10	260	43	24.76	8.00	1.98	45,709
11	280	47	25.35	9.00	2.28	48,895
12	300	50	25.96	10.00	2.60	51,923
13	320	53	26.58	11.00	2.92	54,831
14	340	57	27.22	12.00	3.27	57,648
15	360	60	27.88	13.00	3.62	60,398
16	380	63	28.54	14.00	4.00	63,099
17	400	67	29.23	15.00	4.38	65,768
18	420	70	29.93	16.00	4.79	68,415
19	440	73	30.65	17.00	5.21	71,052
20	460	77	31.39	18.00	5.65	73,688
Total					47.16	860,618
Average Savings Per Year					2.36	43,031
Net Present Value					12.73	273,410

Reduced Operating Costs

Description/Need. The purpose of weighstations and ports-of-entry is to enforce weight regulations, collect commercial vehicle taxes, provide safety inspections and to ensure that credentials are in accordance with state and federal requirements. Unfortunately, as was demonstrated during the Crescent, weighstation traffic flow frequently exceeds weighstation capacity. When this situation occurs, many weighstations are forced to waive trucks through or close the weighstation until queues no longer cause potentially hazardous situations. Still, many other weighstations resolve this situation by eliminating credential checks or allowing vehicles to bypass (if they claim to be empty) on an honor system. The result of exceeding weighstation capacity is overscheduling and bum-out of weighstation personnel.

The Crescent equipment demonstrated the needed functional capabilities to bypass legal vehicles thereby relieving weighmasters of inspecting legal vehicles and allowing them to concentrate their efforts more efficiently.

Assumptions. The following assumptions were made to quantify this benefit:

* Trucks must be AVI-equipped to be bypassed.

* Average daily traffic is 1500 trucks/scale in the first year and increases by 3 percent each of the following years.

* The percentage of trucks equipped with AVI transponders will increase by 5 percent each year beginning in year three and will continue until year eleven. The percentage of trucks equipped with AVI transponders will increase by 1 percent from year eleven to year twenty (based on NCHRP Report 303).

* The medium percentage of AVI-equipped trucks that will be bypassed is 75 percent, as presented in Table 7-14. This assumption is based on an estimated gross vehicle weight screening threshold of 70,000 pounds. As discussed in Chapter 5, this screening tolerance allowed less than 0.5 percent of overweight trucks to be bypassed at the Ashland site. In addition, it was also reported in Chapter 5 that most of the sites evaluated had WIM accuracies similar to that determined at the Ashland site. The site with the lowest accuracy allowed no overweight vehicles to bypass using a weight screening threshold of 50,000 pounds. With regular calibration it is assumed that all sites can maintain this level of accuracy. To examine the sensitivity of the percentage of vehicles bypassed, Tables 7-13 and 7-15 present the results of 50 and 90 percent of vehicles bypassed, respectively.

* The weighstation is open 24 hours per day.

* The average salary of weighstation personnel is $40,000 per year.

* This and other benefits applicable to weighstations are based on the acceptance of Crescent equipment by the weighstation personnel. It is assumed that personnel will fully accept the HELP equipment into the normal operations of the weighstation.

Table 7-13 - ESTIMATED REDUCED WEIGHSTATION OPERATING COSTS
(low case: 50 percent of AVI equipped trucks are bypassed)

Year	Average Daily Traffic Without bypass	Proportion of AVI equipped trucks (%)	Proportion Bypassed (%)	Reduced Traffic	Average Daily Traffic With bypass	Reduced Operating Costs ($)
1	1,500	3	1.50	23	1478	0
2	1,545	6	3.00	46	1499	0
3	1,591	10	5.00	80	1512	0
4	1,639	15	7.50	123	1516	0
5	1,688	20	10.00	169	1519	0
6	1,739	25	12.50	217	1522	0
7	1,791	30	15.00	269	1522	0
8	1,845	35	17.50	323	1522	0
9	1,900	40	20.00	380	1520	40,000
10	1,957	45	22.50	440	1517	40,000
11	2,016	50	25.00	504	1512	40,000
12	2,076	51	25.50	529	1547	40,000
13	2,139	52	26.00	556	1583	40,000
14	2,203	53	26.50	584	1619	40,000
15	2,269	54	27.00	613	1656	40,000
16	2,337	55	27.50	643	1694	40,000
17	2,407	56	28.00	674	1733	80,000
18	2,479	57	28.50	707	1773	80,000
19	2,554	58	29.00	741	1813	80,000
20	2,630	59	29.50	776	1854	80,000
Total						640,000
Average Savings Per Year						32,000
Net Present Value						154,740

Table 7-14 - ESTIMATED REDUCED WEIGHSTATION OPERATING COSTS
(medium case: 75 percent of AVI equipped trucks are bypassed)

Year	Average Daily Traffic Without bypass	Proportion of AVI equipped trucks (%)	Proportion Bypassed (%)	Reduced Traffic	Average Daily Traffic With bypass	Reduced Operating Costs ($)
1	1,500	3	2.25	34	1466	0
2	1,545	6	4.50	70	1475	0
3	1,591	10	7.50	119	1472	0
4	1,639	15	11.25	184	1455	0
5	1,688	20	15.00	253	1435	0
6	1,739	25	18.75	326	1413	40,000
7	1,791	30	22.50	403	1388	40,000
8	1,845	35	26.25	484	1361	40,000
9	1,900	40	30.00	570	1330	40,000
10	1,957	45	33.75	661	1297	80,000
11	2,016	50	37.50	756	1260	80,000
12	2,076	51	38.25	794	1282	80,000
13	2,139	52	39.00	834	1305	80,000
14	2,203	53	39.75	876	1327	80,000
15	2,269	54	40.50	919	1350	80,000
16	2,337	55	41.25	964	1373	80,000
17	2,407	56	42.00	1011	1396	120,000
18	2,479	57	42.75	1060	1419	120,000
19	2,554	58	43.50	1111	1443	120,000
20	2,630	59	44.25	1164	1466	120,000
Total						1,200,000
Average Savings Per Year						60,000
Net Present Value						326,687

Table 7-15 - ESTIMATED REDUCED WEIGHSTATION OPERATING COSTS
(high case: 90 percent of AVI equipped trucks are bypassed)

Year	Average Daily Traffic Without bypass	Proportion of AVI equipped trucks (%)	Proportion Bypassed (%)	Reduced Traffic	Average Daily Traffic With bypass	Reduced Operating Costs ($)
1	1,500	3	2.70	41	1460	0
2	1,545	6	5.40	83	1462	0
3	1,591	10	9.00	143	1448	0
4	1,639	15	13.50	221	1418	0
5	1,688	20	18.00	304	1384	0
6	1,739	25	22.50	391	1348	40,000
7	1,791	30	27.00	484	1307	40,000
8	1,845	35	31.50	581	1264	40,000
9	1,900	40	36.00	684	1216	80,000
10	1,957	45	40.50	793	1165	80,000
11	2,016	50	45.00	907	1109	80,000
12	2,076	51	45.90	953	1123	80,000
13	2,139	52	46.80	1001	1138	120,000
14	2,203	53	47.70	1051	1152	120,000
15	2,269	54	48.60	1103	1166	120,000
16	2,337	55	49.50	1157	1180	120,000
17	2,407	56	50.40	1213	1194	120,000
18	2,479	57	51.30	1272	1207	160,000
19	2,554	58	52.20	1333	1221	160,000
20	2,630	59	53.10	1397	1234	160,000
Total						1,520,000
Average Savings Per Year						76,000
Net Present Value						403,732

Quantification of Benefit. Quantification of this benefit is based on reduced personnel costs associated with an increased weighstation capacity due to automation. The values presented in Tables 7-l 3, 7- 14 and 7-l 5 are based on reduced operating costs reported by Oregon DOT [7]. The Woodburn POE was one of two weighstations that were observed during the demonstration to utilize the Crescent equipment on a daily basis. This POE has been operating a Crescent-type system since 1987 and demonstrates the potential of in-station bypassing through the use of WIM and AVI equipment. However, the Woodburn POE has automated credential checks through the use of a PUC database and not the Crescent database. This variation explains why benefits are not immediately accrued in the results presented in Tables 7-13 through 7-15.

Automated Credentials inspections Scheduling

Description/Need In addition to an increase in the number of trucks being weighed at weighstations, the number of permits issued and credentials checked at weighstations has also increased. According to one report, from 1986 to 1990, there has been a 42% increase in the number of divisible load overweight permits issued and a 29% increase in the number of non-divisible load permits issued [13]. However, the majority of weighstations evaluated during the demonstration have not automated their inspection, collection and processing of credentials. It has been estimated that states currently spend $5 billion annually on the administrative procedures to collect, report and process mileage and fuel information [14].

Assumntions. The following assumptions were made to quantify this benefit:

* The percentage of trucks equipped with AVI transponders will increase by 5 percent each year beginning in year three and will continue until year eleven. The percentage of trucks equipped with AVI transponders will increase by 1 percent from year eleven to year twenty (based on NCHRP report 303).

* The number of trucks in the Crescent corridor is estimated to be 1 million in the first year with an increase of 3 percent annually.

* The annual savings from reduced processing of credentials is assumed to be $40 per AVI equipped truck. Sensitivity analyses are performed on estimates of $25 and $50.

Quantification of Benefit. The value of this benefit is based on estimated savings in Oregon from credential processing due to automation [15]. Oregon weighstations currently maintain a PUC database which stores information on carriers' credentials. The information stored in the database and the processing capabilities are similar to those of the Crescent system database. However, the PUC system operates at a state rather than a regional level. The PUC, which has operated the database for five years at the Woodburn POE, estimates the annual savings due to reduced processing of credentials to be $40 per truck. Tables 7-16, 7-17 and 7-l 8 present the estimated value of the Crescent system, based on estimates of the number of trucks equipped with AVI transponders in the future. As seen in each of the tables, benefits do not accrue until year three, when 10 percent of the truck population is equipped with AVI transponders.

Table 7-16 - AVERAGE SAVINGS DUE TO AUTOMATED CREDENTIALS CHECKING
(low case: $25 savings per truck)

Year	Trucks in the Crescent Corridor (M)	Proportion of AVI equipped trucks (%)	Number of AVI equipped Trucks	Savings per Truck ($)	Regional Savings ($M)	Average State Savings ($M)
1	1.00	3	30,000	-	-	-
2	1.03	6	61,800	-	-	-
3	1.06	10	106,090	25	2.65	0.44
4	1.09	15	163,909	25	4.10	0.68
5	1.13	20	225,102	25	5.63	0.94
6	1.16	25	289,819	25	7.25	1.21
7	1.19	30	358,216	25	8.96	1.49
8	1.23	35	430,456	25	10.76	1.79
9	1.27	40	506,708	25	12.67	2.11
10	1.30	45	587,148	25	14.68	2.45
11	1.34	50	671,958	25	16.80	2.80
12	1.38	51	705,959	25	17.65	2.94
13	1.43	52	741,396	25	18.53	3.09
14	1.47	53	778,323	25	19.46	3.24
15	1.51	54	816,798	25	20.42	3.40
16	1.56	55	856,882	25	21.42	3.57
17	1.60	56	898,636	25	22.47	3.74
18	1.65	57	942,123	25	23.55	3.93
19	1.70	58	987,411	25	24.69	4.11
20	1.75	59	1,034,569	25	25.86	4.31
Total					277.54	46.26
Average Savings Per Year					13.88	2.31
Net Present Value					81.14	13.52

Table 7-17 - AVERAGE SAVINGS DUE TO AUTOMATED CREDENTIALS CHECKING
(medium case: $40 savings per truck)

Year	Trucks in the Crescent Corridor (M)	Proportion of AVI equipped trucks (%)	Number of AVI equipped Trucks	Savings per Truck ($)	Regional Savings ($M)	Average State Savings ($M)
1	1.00	3	30,000	-	-	-
2	1.03	6	61,800	-	-	-
3	1.06	10	106,090	40	4.24	0.71
4	1.09	15	163,909	40	6.56	1.09
5	1.13	20	225,102	40	9.00	1.50
6	1.16	25	289,819	40	11.59	1.93
7	1.19	30	358,216	40	14.33	2.39
8	1.23	35	430,456	40	17.22	2.87
9	1.27	40	506,708	40	20.27	3.38
10	1.30	45	587,148	40	23.49	3.91
11	1.34	50	671,958	40	26.88	4.48
12	1.38	51	705,959	40	28.24	4.71
13	1.43	52	741,396	40	29.66	4.94
14	1.47	53	778,323	40	31.13	5.19
15	1.51	54	816,798	40	32.67	5.45
16	1.56	55	856,882	40	34.28	5.71
17	1.60	56	898,636	40	35.95	5.99
18	1.65	57	942,123	40	37.68	6.28
19	1.70	58	987,411	40	39.50	6.58
20	1.75	59	1,034,569	40	41.38	6.90
Total					444.06	74.01
Average Savings Per Year					22.20	3.70
Net Present Value					129.82	21.64

Table 7-18 - AVERAGE SAVINGS DUE TO AUTOMATED CREDENTIALS CHECKING
(high case: $50 savings per truck)

Year	Trucks in the Crescent Corridor (M)	Proportion of AVI equipped trucks (%)	Number of AVI equipped Trucks	Savings per Truck ($)	Regional Savings ($M)	Average State Savings ($M)
1	1.00	3	30,000	-	-	-
2	1.03	6	61,800	-	-	-
3	1.06	10	106,090	50	5.30	0.88
4	1.09	15	163,909	50	8.20	1.37
5	1.13	20	225,102	50	11.26	1.88
6	1.16	25	289,819	50	14.49	2.42
7	1.19	30	358,216	50	17.91	2.99
8	1.23	35	430,456	50	21.52	3.59
9	1.27	40	506,708	50	25.34	4.22
10	1.30	45	587,148	50	29.36	4.89
11	1.34	50	671,958	50	33.60	5.60
12	1.38	51	705,959	50	35.30	5.88
13	1.43	52	741,396	50	37.07	6.18
14	1.47	53	778,323	50	38.92	6.49
15	1.51	54	816,798	50	40.84	6.81
16	1.56	55	856,882	50	42.84	7.14
17	1.60	56	898,636	50	44.93	7.49
18	1.65	57	942,123	50	47.11	7.85
19	1.70	58	987,411	50	49.37	8.23
20	1.75	59	1,034,569	50	51.73	8.62
Total					555.08	92.51
Average Savings Per Year					27.75	4.63
Net Present Value					162.28	27.05

A utomated Safety Inspection Scheduling

Description/Need. Two methods of identifying carriers for safety inspections were observed during the Crescent on-site evaluations. The first method attempts to randomly select carriers from the weighstation traffic. The second method identifies a truck's last inspection date by viewing an inspection sticker placed on the cab window. While the second method attempts to develop a system that would schedule inspections more efficiently, the process of identifying the stickers was seen to be a difficult task which often left weighstation personnel reverting back to the process of randomly selecting trucks to be inspected. Unfortunately, both of these methods allow many vehicles to continue travel without inspection for extended periods.

One estimate of the number of vehicles that are operating with faulty equipment was provided by Roadcheck 91, a continent-wide review of truck safety. According to a paper which documented the results of Roadcheck 91, 18 percent of 30,700 vehicles stopped were placed out of service due to brake adjustment problems. Others were placed out of service due to electrical system inadequacies, improperly secured freight, and missing or out-of-date credentials [15]. According to another recent report, in 1991 there were 320,000 accidents involving medium and heavy vehicles resulting in 4,800 fatalities [14].

Causal relationships have not been documented for each of the accidents identified, but a report from IVHS America's Commercial Vehicle Operations Committee suggested that if only 10 percent of commercial vehicle accidents associated with faulty equipment were reduced, the savings to the nation's carriers and drivers, as well as the public, would be hundreds of millions of dollars [14].

Assumptions. The following assumptions were made to quantify this benefit:

* The Crescent database does not currently include information on the latest safety inspection of vehicles. This benefit assumes the inclusion of this information into the database, and the presentation of this information on the computer screens viewed by the weighstation personnel.

* The number and cost of accidents reported in Table 7-19, for the state of Washington, is assumed to be typical for all states along the Crescent corridor.

* This benefit assumes that a more efficient scheduling of safety inspections will decrease the number of accidents associated with equipment defects by 25 percent. This value is applied to the population of trucks equipped with AVI transponders. Sensitivity analyses are performed on the percentage reduction in accidents utilizing values of 10 and 50 percent.

Quantification of Benefit. The value of this benefit is based on the number of accidents associated with truck equipment defects. Table 7-19, which was provided by WSDOT, presents the number and cost of accidents involving trucks over 10,000 pounds with defects. The following defects were identified as major factors involved in these accidents:

Table 7-19 Washington State Highway Accidents Involving Trucks over 10K with Defects
January 1, 1988 through December 31, 1992

	1988	1989	1990	1991	1992	Average
Property Damage Accidents	176	195	157	158	170	171
Injury Accidents	139	106	115	91	79	106
Fatal Accidents	7	9	11	8	2	7
Total # of Accidents	322	310	283	257	251	285
Amount of Property Damage	$2,971,824	$3,014,693	$2,824,498	$2,144,474	$2,310,914	$2,653,281
# of Injuries	206	171	219	134	110	168
# of Fatalities	8	9	12	11	3	9

* defective brakes;
* defective headlights;
* defective rear lights;
* tires worn or smooth;
* loss of a wheel;
* defective steering mechanism;
* power failure; and
* other lights, reflectors insufficient.

Each of these items have been identified as standard equipment inspected at weighstation inspection sites. Tables 7-20, 7-21 and 7-22 present the sensitivity analyses and computed value of automated weighstation safety inspections.

Carrier Benefits

Carrier benefits include:

* time savings at weighstations;
* one-stop shopping; and
* fleet management.

Time Savings Due to Bypass

Description/Need According to the American Association of State Highway and Transportation Officials (AASHTO), truck delays add $7.6 billion per year to the cost of goods bought in this country [16].

Table 7-20 - SAVINGS DUE TO AUTOMATED SAFETY INSPECTION SCHEDULES
(low case: 10 percent reduction in accidents)

Year	Cost of Accidents involving trucks with defects ($M)	Proportion of AVI equipped trucks (%)	Potential Cost of Accidents involving AVI equipped trucks with defects ($M)	Reduction in Accidents (%)	Average State Savings ($)
1	2.65	3			
2	2.65	6			
3	2.65	10	0.27	10	26,500
4	2.65	15	0.40	10	39,750
5	2.65	20	0.53	10	53,000
6	2.65	25	0.66	10	66,250
7	2.65	30	0.80	10	79,500
8	2.65	35	0.93	10	92,750
9	2.65	40	1.06	10	106,000
10	2.65	45	1.19	10	119,250
11	2.65	50	1.33	10	132,500
12	2.65	51	1.35	10	135,150
13	2.65	52	1.38	10	137,800
14	2.65	53	1.40	10	140,450
15	2.65	54	1.43	10	143,100
16	2.65	55	1.46	10	145,750
17	2.65	56	1.48	10	148,400
18	2.65	57	1.51	10	151,050
19	2.65	58	1.54	10	153.700
20	2.65	59	1.56	10	156,350
Total					2,027,250
Average Savings Per Year					101,363
Net Present Value					629,640

Table 7-21 - SAVINGS DUE TO AUTOMATED SAFETY INSPECTION SCHEDULES
(medium case: 25 percent reduction in accidents)

Year	Cost of Accidents involving trucks with defects ($M)	Proportion of AVI equipped trucks (%)	Potential Cost of Accidents involving AVI equipped trucks with defects ($M)	Reduction in Accidents (%)	Average State Savings ($)
1	2.65	3	-	-	-
2	2.65	6	-	-	-
3	2.65	10	0.27	25	66,250
4	2.65	15	0.40	25	99,375
5	2.65	20	0.53	25	132,500
6	2.65	25	0.66	25	165,625
7	2.65	30	0.80	25	198,750
8	2.65	35	0.93	25	231,875
9	2.65	40	1.06	25	265,000
10	2.65	45	1.19	25	298,125
11	2.65	50	1.33	25	331,250
12	2.65	51	1.35	25	337,875
13	2.65	52	1.38	25	344,500
14	2.65	53	1.40	25	351,125
15	2.65	54	1.43	25	357,750
16	2.65	55	1.46	25	364,375
17	2.65	56	1.48	25	371,000
18	2.65	57	1.51	25	377,625
19	2.65	58	1.54	25	384,250
20	2.65	59	1.56	25	390,875
Total					5,068,125
Average Savings Per Year					253,406
Net Present Value					1,574,099

Table 7-22 - SAVINGS DUE TO AUTOMATED SAFETY INSPECTION SCHEDULES
(high case: 50 percent reduction in accidents)

Year	Cost of Accidents involving trucks with defects ($M)	Proportion of AVI equipped trucks (%)	Potential Cost of Accidents involving AVI equipped trucks with defects ($M)	Reduction in Accidents (%)	Average State Savings ($)
1	2.65	3	-	-	-
2	2.65	6	-	-	-
3	2.65	10	0.27	50	132,500
4	2.65	15	0.40	50	198,750
5	2.65	20	0.53	50	265,000
6	2.65	25	0.66	50	331,250
7	2.65	30	0.80	50	397,500
8	2.65	35	0.93	50	463,750
9	2.65	40	1.06	50	530,000
10	2.65	45	1.19	50	596,250
11	2.65	50	1.33	50	662,500
12	2.65	51	1.35	50	675,750
13	2.65	52	1.38	50	689,000
14	2.65	53	1.40	50	702,250
15	2.65	54	1.43	50	715,500
16	2.65	55	1.46	50	728,750
17	2.65	56	1.48	50	742,000
18	2.65	57	1.51	50	755,250
19	2.65	58	1.54	50	768,500
20	2.65	59	1.56	50	781,750
Total					10,136,250
Average Savings Per Year					506,813
Net Present Value					3,148,199

There are currently two methods for bypassing being implemented at Crescent weighstation sites. The first method is mainline bypass. This method allows AVI-equipped vehicles to be identified and weighed prior to a weighstation entrance. If the AVI-equipped vehicle is within the weight threshold established by the weighstation, a signal inside the vehicle's cab notifies the driver that bypassing of the weighstation is permitted. The second method of weighstation bypass is in-station bypass. This method utilizes Crescent equipment installed in the entrance ramp of the weighstation. AVI-equipped vehicles that enter the weighstation and meet the established weight thresholds are notified to bypass the static scales, either through an in-cab device or a lane signal installed at the weighstation. The in-station bypass method was demonstrated at the Woodburn, Oregon weighstation, although vehicles were allowed to bypass regardless of whether or not they were AVI-equipped.

Assumptions. The following assumptions were made to quantify this benefit:

* This benefit assumes that Crescent weighstations will be mainline or in-station bypass functional by year one of the twenty years projected throughout this analysis. The majority of weighstations have the necessary WIM, AVC and AVI equipment, although some do not have bypass lanes. Based on interviews conducted during the evaluation, the necessary improvements at most sites are to be implemented within the next twelve months.

* In determining the annual benefit of weighstation bypass, its is assumed that carriers operate 5 days per week, 52 weeks per year and encounter an average of two weighstations per day.

* It is assumed that weighstation bypass ramps will be of sufficient length to allow for vehicles to be identified and the lane signal to be activated.

Quantification of Benefit. Tables 7-24 and 7-25 present the estimated savings to carriers from mainline and in-station bypass of static weight scales. These tables derive their value by multiplying the carrier's value of time by the time saved by bypassing the static scales. Sensitivity analyses are performed on the carrier's value of time utilizing values of $0.83 per minute for the medium value, $0.50 for the low and $1.00 for the high.

Sensitivity analyses are also performed on the transit time for statically-weighed vehicles. Table 7-23 presents the average transit delay time for statically-weighed vehicles, derived from the on-site testing, for each of the weighstations evaluated. The sensitivity analyses performed in Tables 7-24 and 7-25 utilize the low, medium and high values presented in Table 7-23.

Average transit time for mainline bypassed vehicles of 0.3 minutes is based on an average travel speed of 55 mph and an average distance from weighstation entrance to exit of 0.25 miles. Average transit time for in-station bypass of 1.083 minutes is based on the average transit time for in-station bypass that was observed at the Woodburn POE during the evaluation.

Table 7-23 Average Weighstation Transit DelayTime for Statically Weighed Vehicles

Transit Time (Seconds)

Bow Hill	Woodburn	Ashland	Santa Nella	Banning	Lordsburg	San Simon	Average Transit Time for All Sites
146	120	188	155	420	173	216	203

Table 7-24 - ESTIMATED SAVINGS FROM MAINLINE BYPASS

Carrier's value of Time ($/min)	Transit time for statically weighed vehicles (min)	Transit time for bypassed vehicles (min)	Time saved due to bypass (min)	Savings per bypassed weighstation ($)	Number of weighstations encountered per day	Total annual savings per truck ($)
0.50	2.00	0.3	1.70	0.85	2	442.00
0.50	3.38	0.3	3.08	1.54	2	800.80
0.50	7.00	0.3	6.70	3.35	2	1,742.00
0.83	2.00	0.3	1.70	1.41	2	733.72
0.83	3.38	0.3	3.08	2.56	2	1,329.33
0.83	7.00	0.3	6.70	5.56	2	2,891.72
1.00	2.00	0.3	1.70	1.70	2	884.00
1.00	3.38	0.3	3.08	3.08	2	1,601.60
1.00	7.00	0.3	6.7	6.70	2	3,484.00

Table 7-25 - ESTIMATED SAVINGS FROM IN-STATION BYPASS

Carrier's value of Time ($/min)	Transit time for statically weighed vehicles (min)	Transit time for bypassed vehicles (min)	Time saved due to bypass (min)	Savings per bypassed weighstation ($)	Number of weighstations encountered per day	Total annual savings per truck ($)
0.50	2.00	1.08	0.92	0.46	2	238.42
0.50	3.38	1.08	2.30	1.15	2	597.22
0.50	7.00	1.08	5.92	2.96	2	1,538.42
0.83	2.00	1.08	0.92	0.76	2	395.78
0.83	3.38	1.08	2.30	1.91	2	991.39
0.83	7.00	1.08	5.92	4.91	2	2,553.78
1.00	2.00	1.08	0.92	0.92	2	476.84
1.00	3.38	1.08	2.30	2.30	2	1,194.44
1.00	7.00	1.08	5.917	5.92	2	3,076.84

One-Stop Shopping

Description/Need. One-stop shopping is defined in this analysis as the benefit which allows carriers to save time and money by obtaining credentials for all states traveled at a single location. Carriers are currently required to maintain mileage and vehicle information records for each trip taken on an Individual Vehicle Mileage Record (IVMR) for registration and audits. The National Trucking Association and the National Private Truck Council estimate that between $5 and $6 billion is spent annually by U.S. carriers to administratively comply with regulatory and taxation laws [10].

Assumptions. The following assumption was made to quantify this benefit:

* This benefit assumes that institutional barriers can be overcome resulting in a cooperative one-stop shopping agreement between all HELP states. It is further assumed that this agreement will be in place by year three of the projected 20 years presented throughout this analysis.

Quantification of Benefit. A recent survey of carriers found the average value of clerical time spent obtaining licenses, permits and registration was $84.70 per tractor per year [15]. It is assumed that these costs can be reduced by $40 annually through one-stop shopping. This estimate is based on a similar analysis provided by the Oregon PUC for the value of one-stop shopping in that state [7] Furthermore, this estimate is considered to be conservative since the PUC analysis is based on the value of one-stop shopping in the State of Oregon alone.

Fleet Management

Description/Need The benefit of fleet management is defined in this analysis as the use of AVI fleet tracking to improve carrier efficiency. Carriers currently utilize fleet tracking not only to identify a specific shipment's location, but also to plan routes, avoid congested areas, improve scheduling of pickup and deliveries and relieve some of the costs associated with mileage tracking and vehicle log reporting. While a network of AVI readers does not offer the pinpoint location capabilities of GPS, the Crescent system has been identified as a low-cost alternative and could provide the required level of location accuracy for route planning, scheduling and mileage tracking.

Assumptions. The following assumptions were made to quantify this benefit:

* This benefit is based on a widespread network of AVI readers within the Crescent corridor. Benefits of fleet management are not expected to accrue until the third year when 120 Crescent sites will be in place.

* This benefit assumes that most carriers that are interested in fleet management will require the location of their vehicles to within ±10 miles while the vehicle is traveling on an interstate highway.

* This benefit assumes that Crescent sites are located approximately equidistant apart, allowing a more complete AVI coverage.

Quantification. Many carriers currently pay installation costs in excess of $2000 per vehicle in addition to annual user fees and operating expenses as high as $500 per vehicle to track fleet movements with GPS or similar equipment.

The value of this benefit is based on the amount of AVI coverage in the Crescent corridor. It is assumed that most carriers require the location of their fleet within +/- 10 miles. Therefore, this benefit is quantified by multiplying the fractional percentage of AVI coverage in the Crescent corridor by the average annual cost of a GPS system for fleet tracking. The average annual cost of GPS fleet tracking, including the initial installation and service charges is estimated to be $500 per vehicle. The analysis is presented in Table 7-26.

Extrapolated Benefits and Associated Costs for Crescent Configurations

This section of the cost-benefit analysis calculates the costs and identifies the benefits applicable to each of the Crescent site configurations. In addition, a qualitative analysis is presented that assesses the functionality of the equipment configurations based on observations conducted during the evaluations. A table containing the complete cost-benefit analysis is presented for each of the site configurations. Each table shows the individual equipment costs as well as the net benefit and benefit-to-cost ratio over a 20-year period. All costs and benefits presented in the tables are extrapolated from the previous two sections. The following assumptions were made in preparing each of the tables:

* Many of the benefits are based on the number of sites installed. Therefore, the cost-benefit analysis presented assumes that other sites of the same type exist in order to obtain the identified benefits. However, the benefits and costs in the tables are calculated for a single installation.

* Regional costs are divided equally among all sites. Therefore, the cost per site for regional equipment is progressively lower each year due to the increase in the number of Crescent sites.

* Replacement costs for all state and carrier equipment are assessed in year ten of the twenty years projected in the analysis.

* A 10 percent interest rate is used to assess costs and benefits when calculating net present value.

* When determining the cost of equipment at mainline sites, it is assumed that Crescent equipment is installed in two lanes.

* A bypass users fee is assessed to carriers for mainline bypass scenarios only.

Table 7-26 - ESTIMATED VALUE OF FLEET MANAGEMENT

Year	Total Number of HELP Sites	Amount of highway in the HELP corridor (miles)	Average distance between AVI antennas (miles)	Proportion of highway coverage (%)	Annual value of Fleet Management ($)
1	80	3000	37.50	26.67	133.33
2	100	3000	30.00	33.33	166.67
3	120	3000	25.00	40.00	200.00
4	140	3000	21.43	46.67	233.33
5	160	3000	18.75	53.33	266.67
6	180	3000	16.67	60.00	300.00
7	200	3000	15.00	66.67	333.33
8	220	3000	13.64	73.33	366.67
9	240	3000	12.50	80.00	400.00
10	260	3000	11.54	86.67	433.33
11	280	3000	10.71	93.33	466.67
12	300	3000	10.00	100.00	500.00
13	320	3000	9.38	100.00	500.00
14	340	3000	8.82	100.00	500.00
15	360	3000	8.33	100.00	500.00
16	380	3000	7.89	100.00	500.00
17	400	3000	7.50	100.00	500.00
18	420	3000	7.14	100.00	500.00
19	440	3000	6.82	100.00	500.00
20	460	3000	6.52	100.00	500.00
Total					7,500
Average Savings Per Year					375
Net Present Value					2,755

* The financial analysis produced for carriers is based on a trucking company with 100 vehicles equipped with AVI transponders. The tables produced present the total costs and benefits to the company (i.e., benefits and costs per 100 vehicles).

Crescent site configurations

Crescent site configurations include:

* Type I: Mainline site with AVI only and full lane coverage;
* Type II: Mainline site with AVI only and partial lane coverage;
* Type III: Mainline site with WIM and AVI and full lane coverage;
* Type IV: Mainline site with WIM and AVI and partial lane coverage;
* Type V: Weighstation with AVI only, without bypass lane;
* Type VI: Weighstation with AVI only, with bypass lane;
* Type VII: Weighstation with WIM and AVI in ramp, with bypass lane, with AVI in bypass/scale lane;
* Type VIII: Weighstation with WIM and AVI in ramp, with bypass lane, without AVI in bypass/scale lane;
* Type IX: Weighstation with WIM and AVI in bypass lane only;
* Type X: Weighstation with WIM and AVI prior to AVI only static scale lane; and
* Type XI: Mainline weight screening site

Type I: Mainline site with A VI and full lane coverage

Two of the Crescent mainline sites were AVI-only with full lane coverage installations. These sites were Bow Hill, Washington and Hilt, California The Type I site configuration offers the benefits of hazardous material tracking and improved collection of mileage-based taxes to states. In determining improved tax collection as a viable benefit for this configuration, this analysis assumes that vehicle weights will be determined at other Crescent installations equipped with WIM. When placed strategically between installations that provide the required weight information, this configuration acts as a low-cost link that provides the needed distance information for the benefit. The net benefit to states, as determined by the net present value over a 20-year period, is $30,769.

Carriers obtain the benefit of fleet management from this configuration. The full lane coverage ensures AVI reads and prevents potential accidents that may occur if AVI-equipped trucks are attempting to switch lanes in order to be identified by the AVI antenna. The net benefit to carriers, as determined by the net present value over a 20-year period, is $259,401.

The cost-benefit analysis is presented in Table 7-27.

Type II: Mainline site with A VI only and partial lane coverage

Three of the Crescent mainline sites were Type II installations. These sites were Tacoma 84th Street, Tacoma 56th Street and Tacoma 38th Street in Washington. These Crescent sites were originally assumed to have the potential to allow carriers and states the ability to identify congestion in urban centers. Unfortunately, this scenario requires the AVI-equipped vehicles to be in the lane installed with the AVI antenna which presents a potentially hazardous situation if vehicles are attempting to cross lanes in order to be in the correct lane. This scenario also requires installations to be relatively closely spaced so that an accurate depiction of traffic conditions can be determined thereby creating a more expensive configuration overall. In addition, for interstate and other limited access highways, which are the basis of the Crescent network, these installations offer none of the benefits identified in the previous section.

The net loss to states, as determined by the net present value over a 20-year period, is $128,303. The net loss to carriers, as determined by the net present value over a 20-year period is $16,113.

The cost-benefit analysis is presented in Table 7-28.

Type III: Mainline site with WIM and A VI and full lane coverage

Fifteen of the Crescent mainline sites were Type III installations. These sites include:

* I-205 Portland Oregon;
* Jefferson, Oregon;
* Ashland, Oregon;
* Redding, California;
* Lodi, California;
* India, California;
* Bakersfield, California;
* Newhall, California;

Table 7-27 Benefits and Costs of a Type I Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AVI	14,000	0	0	0	0	0	0	0	0	14,000	0	0	0	0	0	0	0	0	0	0	28,000	18,125
State Computer Terminal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lane Signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weighstation Computer System	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communications	2,000	0	0	0	0	0	0	0	0	2,000	0	0	0	0	0	0	0	0	0	0	4,000	2,589
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	20,500	0	0	0	0	0	0	0	0	19,269	0	0	0	0	0	0	0	0	0	0	39,769	26,065
Annual Costs:																						
Operating Costs																						
Equipment & Communications	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	142,000	60,446
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	17,725	15,600	14,183	13,171	12,413	11,822	11,350	10,964	10,642	10,369	10,136	9,933	9,756	9,600	9,461	9,337	9,225	9,124	9,032	8,948	222,791	105,130
Total State Costs	38,225	15,600	14,183	13,171	12,413	11,822	11,350	10,964	10,642	29,638	10,136	9,933	9,756	9,600	9,461	9,337	9,225	9,124	9,032	8,948	262,560	131,196
State Benefits: (value per site)																						
Hazardous material tracking	0	0	9,096	9,823	10,529	11,231	11,940	12,664	13,408	14,177	14,974	15,804	16,668	17,570	18,512	19,498	20,530	21,610	21,660	21,754	281,448	92,745
Improved collection of weight/distance taxes	0	0	5,190	6,634	8,164	9,289	10,273	11,157	11,968	12,727	13,446	13,108	12,830	12,603	12,419	12,271	12,154	12,065	11,999	11,956	200,452	69,220
Total State Benefits	0	0	14,286	16,457	18,693	20,520	22,213	23,820	25,376	26,904	28,420	28,911	29,498	30,173	30,931	31,769	32,684	33,675	33,659	33,710	481,900	161,965
Benefits - Costs	(38,225)	(15,600)	103	3,485	6,281	8,698	10,863	12,857	14,735	(2,735)	18,285	18,978	19,742	20,573	21,470	22,432	23,459	24,551	24,627	24,762	219,340	30,769
Benefit/Cost Ratio	0.00	0.00	1.01	1.26	1.51	1.74	1.96	2.17	2.38	0.91	2.80	2.91	3.02	3.14	3.27	3.40	3.54	3.69	3.73	3.77	1.84	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,818
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,896
Annual Costs:																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Total Carrier Costs	6,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	4,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	32,300	16,113
Carrier Benefits (value per 100 trucks)																						
Fleet Management	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Total Carrier Benefits	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Benefits - Costs	6,983	15,467	18,800	22,133	25,467	28,800	32,133	35,467	38,800	38,983	45,467	48,800	48,800	48,800	48,800	48,800	48,800	48,800	48,800	48,800	747,700	259,401
Benefits/Costs Ratio	2.10	13.89	16.67	19.44	22.22	25.00	27.78	30.56	33.33	9.96	38.89	41.67	41.67	41.67	41.67	41.67	41.67	41.67	41.67	41.67	24.15	

Table 7-28 Benefits and Costs of a Type II Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs.																						
Capital and Installation																						
WIM/AVC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AVI	12,000	0	0	0	0	0	0	0	0	12,000	0	0	0	0	0	0	0	0	0	0	24,000	15,536
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weighstation Computer System	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communications	2,000	0	0	0	0	0	0	0	0	2,000	0	0	0	0	0	0	0	0	0	0	4,000	2,589
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	18,595	0	0	0	0	0	0	0	0	17,364	0	0	0	0	0	0	0	0	0	0	35,958	23,599
Annual Costs.																						
Operating Costs																						
Equipment & Communications	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	7,050	141,000	60,021
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	17,675	15,550	14,133	13,121	12,363	11,772	11,300	10,914	10,592	10,319	10,086	9,883	9,706	9,550	9,411	9,287	9,175	9,074	8,982	8,898	221,791	104,705
Total State Costs	36,270	15,550	14,133	13,121	12,363	11,772	11,300	10,914	10,592	27,683	10,086	9,883	9,706	9,550	9,411	9,287	9,175	9,074	8,982	8,898	257,749	128,303
State Benefits: (value per site)																						
Total State Benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits - Costs	(36,270)	(15,550)	(14,133)	(13,121)	(12,363)	(11,772)	(11,300)	(10,914)	(10,592)	(27,683)	(10,086)	(9,883)	(9,706)	(9,550)	(9,411)	(9,287)	(9,175)	(9,074)	(8,982)	(8,898)	(257,749)	(128,303)
Benefit/Cost Ratio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,818
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,896
Annual Costs:																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Total Carrier Costs	6,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	4,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	32,300	16,113
Carrier Benefits (value per 100 trucks)																						
Total Carrier Benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits - Costs	(6,350)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(4,350)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(1,200)	(32,300)	(16,113)
Benefits/Costs Ratio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

* Santa Nella, California;

* Marana, Arizona;

* S. Phoenix, Arizona;

* El Paso, Texas;

* Kerrville, Texas;

* Seguin, Texas; and

* Colorado City, Texas.

The Type III installation offers all of the mainline state and carrier benefits identified for Type I sites. The Type III site configuration is considered the most comprehensive, as well as most cost-effective mainline site installation.

The net benefit to states, as determined by the net present value over a 20-year period, is $453,519. The net benefit to a trucking company, as determined by the net present value over a 20-year period, is $259,401.

The cost-benefit analysis for a Type III installation is presented in Table 7-29.

Type IV: Mainline site with WIM and A VI and partial lane coverage

The Kelso, Washington site was the only mainline site configured with WIM and AVI and partial lane coverage. As with the Type II site configuration, this configuration provides no benefits to carriers, as displayed in Table 7-30. Carriers derive a net loss, as determined by the net present value over a 20-year period, of $458,818.

The only benefit derived by states for this site configuration is for data collection. The data collection benefit for this configuration assumes that traffic weight data, for the lane without the WIM equipment, can be extrapolated from the data obtained from the WIM-equipped lane. The cost of this configuration is reduced by 50 percent due to the reductions associated with gathering weight data from only one lane instead of two. However, as displayed in the table, a net loss to states of $62,726 accrues from this configuration.

Both Type II and Type IV site configurations should be upgraded to derive the benefits calculated for Types I and III equipment configurations.

Table 7-29 Benefits and Costs of a Type III Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	80,000	0	0	0	0	0	0	0	0	80,000	0	0	0	0	0	0	0	0	0	0	160,000	103,571
AVI	14,000	0	0	0	0	0	0	0	0	14,000	0	0	0	0	0	0	0	0	0	0	28,000	18,125
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weighstation Computer System	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communications	2,000	0	0	0	0	0	0	0	0	2,000	0	0	0	0	0	0	0	0	0	0	4,000	2,589
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	100,595	0	0	0	0	0	0	0	0	99,364	0	0	0	0	0	0	0	0	0	0	199,958	129,759
Annual Costs:																						
Operating Costs																						
Equipment & Communications	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	150,000	63,852
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	500,000	212,839
Total Annual Costs	43,125	41,000	39,583	38,571	37,813	37,222	36,750	36,364	36,042	35,769	35,536	35,333	35,156	35,000	34,861	34,737	34,625	34,524	34,432	34,348	730,791	321,375
Total State Costs	143,720	41,000	39,583	38,571	37,813	37,222	36,750	36,364	36,042	135,133	35,536	35,333	35,156	35,000	34,861	34,737	34,625	34,524	34,432	34,348	930,749	451,134
State Benefits: (value per site)																						
Data Collection	55,373	57,034	58,745	60,508	62,323	64,192	66,118	68,102	70,145	72,249	74,417	76,649	78,949	81,317	83,757	86,269	88,857	91,523	94,269	97,097	1,487,893	578,674
Hazardous material tracking	0	0	9,096	9,823	10,529	11,231	11,940	12,664	13,408	14,177	14,974	15,804	16,666	17,570	18,512	19,498	20,530	21,610	21,660	21,754	281,448	92,745
Improved collection of weigh/distance taxes	0	0	5,190	6,834	8,164	9,289	10,273	11,157	11,988	12,727	13,446	13,108	12,830	12,603	12,419	12,271	12,154	12,065	11,999	11,956	200,452	69,220
Mainline weight enforcement	3,750	6,144	10,486	13,805	16,493	18,765	20,753	22,539	24,179	25,711	27,164	28,558	29,908	31,226	32,522	33,803	35,076	36,345	37,616	38,891	483,838	164,014
Total State Benefits	59,123	63,178	83,517	90,970	97,509	103,477	109,084	114,461	119,700	124,864	130,001	134,118	138,354	142,716	147,210	151,841	156,617	161,544	165,544	169,697	2,453,631	904,653
Benefits - Costs	(84,597)	22,178	43,934	52,398	59,696	66,255	72,334	78,097	83,658	(10,269)	94,465	98,785	103,198	107,716	112,349	117,104	121,992	127,020	131,112	135,349	1,522,882	453,519
Benefit/Cost Ratio	0.41	1.54	2.11	2.36	2.58	2.78	2.97	3.15	3.32	0.92	3.66	3.80	3.94	4.08	4.22	4.37	4.52	4.68	4.81	4.94	2.64	
Carrier Costs																						
Initial Costs.																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,618
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,896
Annual Costs:																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Total Carrier Costs	6,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	4,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	32,300	16,113
Carrier Benefits (value per 100 trucks)																						
Fleet Management	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Total Carrier Benefits	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Benefits - Costs	6,983	15,467	18,800	22,133	25,467	28,800	32,133	35,467	38,800	38,983	45,467	48,800	48,800	48,800	48,800	48,800	48,800	48,800	48,800	48,800	747,700	259,401
Benefits/Costs Ratio	2.10	13.89	16.67	19.44	22.22	25.00	27.78	30.56	33.33	9.96	38.89	41.67	41.67	41.67	41.67	41.67	41.67	41.67	41.67	41.67	24.15	

Table 7-30 Benefits and Costs of a Type IV Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	40,000	0	0	0	0	0	0	0	0	40,000	0	0	0	0	0	0	0	0	0	0	80,000	51,785
AVI	12,000	0	0	0	0	0	0	0	0	12,000	0	0	0	0	0	0	0	0	0	0	24,000	15,536
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weighstation Computer System	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communications	2,000	0	0	0	0	0	0	0	0	2,000	0	0	0	0	0	0	0	0	0	0	4,000	2,589
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	58,595	0	0	0	0	0	0	0	0	57,364	0	0	0	0	0	0	0	0	0	0	115,958	75,384
Annual Costs:																						
Operating Costs																						
Equipment & Communications	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	7,250	145,000	61,723
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	400,000	170,271
Total Annual Costs	37,875	35,750	34,333	33,321	32,563	31,972	31,500	31,114	30,792	30,519	30,286	30,083	29,906	29,750	29,611	29,487	29,375	29,274	29,182	29,098	625,791	276,679
Total State Costs	96,470	35,750	34,333	33,321	32,563	31,972	31,500	31,114	30,792	87,883	30,286	30,083	29,906	29,750	29,611	29,487	29,375	29,274	29,182	29,098	741,749	352,063
State Benefits: (value per site)																						
Data Collection	27,687	28,517	29,373	30,254	31,161	32,096	33,059	34,051	35,072	36,125	37,208	38,325	39,474	40,659	41,878	43,135	44,429	45,762	47,134	48,548	743,947	289,337
Total State Benefits	27,687	28,517	29,373	30,254	31,161	32,096	33,059	34,051	35,072	36,125	37,208	38,325	39,474	40,659	41,878	43,135	44,429	45,762	47,134	48,548	743,947	289,337
Benefits - Costs	(68,783)	(7,233)	(4,961)	(3,068)	(1,401)	124	1,559	2,937	4,281	(51,758)	6,923	8,241	9,568	10,909	12,267	13,648	15,054	16,488	17,953	19,451	2,198	(62,726)
Benefit/Cost Ratio	0.29	0.80	0.86	0.91	0.96	1.00	1.05	1.09	1.14	0.41	1.23	1.27	1.32	1.37	1.41	1.46	1.51	1.56	1.62	1.67	1.00	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,618
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,684
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,696
Annual Costs:																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Users Fee	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	1,040,000	442,705
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	1,064,000	452,922
Total Carrier Costs	58,350	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	56,350	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	1,072,300	458,618
Carrier Benefits (value per 100 trucks)																						
Total Carrier Benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits - Costs	(58,350)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(56,350)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(53,200)	(1,072,300)	(458,618)
Benefits/Costs Ratio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Type V: Weighstation with A VI only, without bypass lane

The Lordsburg, New Mexico site was the only Crescent installation equipped with AVI only, without a bypass lane. This configuration offers benefits to the states of hazardous material tracking, improved collection of mileage-based taxes, automated credentials inspections and automated scheduling of safety inspections. The net benefit to states, as determined by the net present value over a 20-year period, is $598,145. Carrier benefits derived from this installation include one-stop shopping and fleet management. The net benefit to carriers over a 20-year period is $16,113.

The Type V site configuration does not provide benefits to the states of reduced operating costs or the carrier benefit of time savings due to bypass. However, this configuration offers the best selection of benefits to both carriers and states if installed at a weighstation which does not have the problems associated with overcapacity.

Table 7-31 presents the cost-benefit analysis for this site configuration.

Type VI: Weighstation with AVI only, with bypass lane

Two Crescent sites are installed with AVI only, with a bypass lane. These sites are Banning, California and Mount Shasta, California. The benefits derived from this installation are identical to those of a Type V site, which is not equipped with a bypass lane. This site configuration does not offer the potential benefit of reduced operating costs to states or the benefit of in-station bypassing to carriers, since there is no way to determine vehicle weight. Although the additional cost of providing a bypass lane is not considered in this analysis, the Type V Crescent installation is considered more advantageous for the benefits derived.

As presented in Table 7-32, the net benefit to both states and carriers is the same as those displayed in a Type V site

Type VII: Weighstation with WIM and AVI in ramp, with bypass lane, with A VI in bypass/scale lane

Ehrenburg, Arizona is the only Crescent site installed with the Type VII configuration. This configuration provides all of the identified state and carrier weighstation benefits of the previous section. In addition, this configuration provides a redundant AVI antenna in the bypass/scale lane. This allows weighstation personnel to be notified if a vehicle that is not AVI-equipped attempts to bypass the static scale. Although this site configuration derives a net benefit to states that is slightly lower than the Type VIII site configuration, the additional AVI in the bypass lane is considered advantageous.

The net benefit to states is $679,915 while the net benefit to carriers is $1,139,072, as determined by the net present value over a 20-year period. The cost-benefit analysis for this site configuration is presented in Table 7-33.

Table 7-31 Benefits and Costs of a Type V Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AVI	12,000	0	0	0	0	0	0	0	0	12,000	0	0	0	0	0	0	0	0	0	0	24,000	15,536
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weighstation Computer System	17,300	0	0	0	0	0	0	0	0	17,300	0	0	0	0	0	0	0	0	0	0	34,600	22,397
Communications	900	0	0	0	0	0	0	0	0	900	0	0	0	0	0	0	0	0	0	0	1,800	1,165
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	34,795	0	0	0	0	0	0	0	0	33,564	0	0	0	0	0	0	0	0	0	0	68,358	44,572
Annual Costs:																						
Operating Costs																						
Equipment & Communications	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	9,000	3,831
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	11,075	8,950	7,533	6,521	5,763	5,172	4,700	4,314	3,992	3,719	3,486	3,283	3,106	2,950	2,811	2,687	2,575	2,474	2,382	2,298	89,791	48,515
Total State Costs	45,870	8,950	7,533	6,521	5,763	5,172	4,700	4,314	3,992	37,283	3,486	3,283	3,106	2,950	2,811	2,687	2,575	2,474	2,382	2,298	158,149	93,087
State Benefits: (value per site)																						
Hazardous material tracking	0	0	9,096	9,823	10,529	11,231	11,940	12,664	13,408	14,177	14,974	15,804	16,666	17,570	18,512	19,498	20,530	21,610	21,660	21,754	281,448	92,745
Improved collection of weight/distance taxes	0	0	5,190	6,834	8,164	9,289	10,273	11,157	11,968	12,727	13,446	13,108	12,830	12,603	12,419	12,271	12,154	12,065	11,999	11,956	200,452	69,220
Automated credentials inspections	0	0	35,363	46,831	56,275	64,404	71,643	78,265	84,451	90,330	95,994	94,128	92,674	91,567	90,755	90,198	89,864	89,726	89,765	89,962	1,442,198	491,687
Automated safety inspection scheduling	0	0	3,312	4,259	4,969	5,521	5,963	6,324	6,625	6,880	7,098	6,758	6,459	6,196	5,963	5,753	5,565	5,395	5,240	5,098	103,377	37,580
Total State Benefits	0	0	52,962	67,747	79,937	90,445	99,818	108,409	116,453	124,114	131,513	129,797	128,632	127,937	127,649	127,720	128,112	128,796	128,663	128,770	2,027,474	691,232
Benefits - Costs	(45,870)	(8,950)	45,429	61,226	74,175	85,273	95,118	104,095	112,461	86,831	128,027	126,514	125,526	124,987	124,838	125,033	125,537	126,322	126,282	126,473	1,869,325	598,145
Benefit/Cost Ratio	0.00	0.00	7.03	10.39	13.87	17.49	21.24	25.13	29.17	3.33	37.73	39.53	41.41	43.37	45.41	47.54	49.75	52.06	54.02	56.04	12.82	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,818
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,896
Annual Costs:																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Total Carrier Costs	6,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	4,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	32,300	16,113
Carrier Benefits (value per 100 trucks)																						
One-stop shopping	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	80,000	34,054
Fleet Management	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Total Carrier Benefits	17,333	20,667	24,000	27,333	30,667	34,000	37,333	40,667	44,000	47,333	50,667	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	860,000	309,568
Benefits - Costs	10,983	19,467	22,800	26,133	29,467	32,800	36,133	39,467	42,800	42,983	49,467	52,800	52,800	52,800	52,800	52,800	52,800	52,800	52,800	52,800	827,700	293,455
Benefits/Costs Ratio	2.73	17.22	20.00	22.78	25.56	28.33	31.11	33.89	36.67	10.88	42.22	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	26.63	

Table 7-32 Benefits and Costs of a Type VI Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AVI	12,000	0	0	0	0	0	0	0	0	12,000	0	0	0	0	0	0	0	0	0	0	24,000	15,536
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weighstation Computer System	17,300	0	0	0	0	0	0	0	0	17,300	0	0	0	0	0	0	0	0	0	0	34,600	22,397
Communications	900	0	0	0	0	0	0	0	0	900	0	0	0	0	0	0	0	0	0	0	1,800	1,165
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	34,795	0	0	0	0	0	0	0	0	33,564	0	0	0	0	0	0	0	0	0	0	68,358	44,572
Annual Costs:																						
Operating Costs																						
Equipment & Communications	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	9,000	3,831
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	11,075	8,950	7,533	6,521	5,763	5,172	4,700	4,314	3,992	3,719	3,486	3,283	3,106	2,950	2,811	2,687	2,575	2,474	2,382	2,298	89,791	48,515
Total State Costs	45,870	8,950	7,533	6,521	5,763	5,172	4,700	4,314	3,992	37,283	3,486	3,283	3,106	2,950	2,811	2,687	2,575	2,474	2,382	2,298	158,149	93,087
State Benefits: (value per site)																						
Hazardous material tracking	0	0	9,096	9,823	10,529	11,231	11,940	12,664	13,408	14,177	14,974	15,804	16,668	17,570	18,512	19,498	20,530	21,610	21,660	21,754	261,446	92,745
Improved collection of weight/distance taxes	0	0	5,190	6,834	8,164	9,289	10,273	11,157	11,966	12,727	13,446	13,108	12,830	12,603	12,419	12,271	12,154	12,065	11,999	11,956	200,452	69,220
Automated credentials inspections	0	0	35,363	46,831	56,275	64,404	71,843	78,285	84,451	90,330	95,994	94,126	92,674	91,587	90,755	90,198	89,864	89,726	89,765	89,962	1,442,198	491,667
Automated safety inspection scheduling	0	0	3,312	4,259	4,969	5,521	5,983	6,324	6,625	6,880	7,098	6,758	6,459	6,196	5,963	5,753	5,565	5,395	5,240	5,098	103,377	37,580
Total State Benefits	0	0	52,962	67,747	79,937	90,445	99,818	108,409	116,453	124,114	131,513	129,797	128,632	127,937	127,649	127,720	128,112	128,798	128,663	128,770	2,027,474	691,232
Benefits - Costs	(45,870)	(8,950)	45,429	61,226	74,175	85,273	95,118	104,095	112,461	86,831	128,027	126,514	125,526	124,987	124,838	125,033	125,537	126,322	126,282	126,473	1,869,325	598,145
Benefit/Cost Ratio	0.00	0.00	7.03	10.39	13.87	17.49	21.24	25.13	29.17	3.33	37.73	39.53	41.41	43.37	45.41	47.54	49.75	52.08	54.02	56.04	12.82	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,618
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,696
Annual Costs:																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Total Carrier Costs	6,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	4,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	32,300	16,113
Carrier Benefits (value per 100 trucks)																						
One-stop shopping	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	80,000	34,054
Fleet Management	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Total Carrier Benefits	17,333	20,667	24,000	27,333	30,667	34,000	37,333	40,667	44,000	47,333	50,667	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	860,000	309,568
Benefits - Costs	10,983	19,467	22,800	26,133	29,467	32,800	36,133	39,467	42,800	42,983	49,467	52,800	52,800	52,800	52,800	52,800	52,800	52,800	52,800	52,800	827,700	293,455
Benefits/Costs Ratio	2.73	17.22	20.00	22.78	25.56	28.33	31.11	33.89	36.67	10.88	42.22	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	26.83	

Table 7-33 Benefits and Costs of a Type VII Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	40,000	0	0	0	0	0	0	0	0	40,000	0	0	0	0	0	0	0	0	0	0	80,000	51,785
AVI	14,000	0	0	0	0	0	0	0	0	14,000	0	0	0	0	0	0	0	0	0	0	28,000	18,125
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	15,000	0	0	0	0	0	0	0	0	15,000	0	0	0	0	0	0	0	0	0	0	30,000	19,420
Weighstation Computer System	17,300	0	0	0	0	0	0	0	0	17,300	0	0	0	0	0	0	0	0	0	0	34,600	22,397
Communications	900	0	0	0	0	0	0	0	0	900	0	0	0	0	0	0	0	0	0	0	1,800	1,165
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	91,795	0	0	0	0	0	0	0	0	90,564	0	0	0	0	0	0	0	0	0	0	182,358	118,366
Annual Costs:																						
Operating Costs																						
Equipment & Communications	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	11,000	4,682
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	400,000	170,271
Total Annual Costs	31,175	29,050	27,633	26,621	25,863	25,272	24,800	24,414	24,092	23,819	23,586	23,383	23,206	23,050	22,911	22,787	22,675	22,574	22,482	22,398	491,791	219,638
Total State Costs	122,970	29,050	27,633	26,621	25,863	25,272	24,800	24,414	24,092	114,383	23,586	23,383	23,206	23,050	22,911	22,787	22,675	22,574	22,482	22,398	674,149	338,004
State Benefits: (value per site)																						
Hazardous material tracking	0	0	9,096	9,823	10,529	11,231	11,940	12,664	13,408	14,177	14,974	15,804	16,668	17,570	18,512	19,498	20,530	21,610	21,660	21,754	261,448	92,745
Improved collection of weigh/distance taxes	0	0	5,190	6,834	8,184	9,289	10,273	11,157	11,966	12,727	13,446	13,108	12,830	12,603	12,419	12,271	12,154	12,065	11,999	11,956	200,452	69,220
Reduced operating costs	0	0	0	0	0	40,000	40,000	40,000	40,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	120,000	120,000	120,000	120,000	1,200,000	326,687
Automated credentials inspections	0	0	35,363	46,631	56,275	64,404	71,643	78,285	84,451	90,330	95,994	94,128	92,674	91,567	90,755	90,198	89,864	89,726	89,765	89,962	1,442,198	491,687
Automated safety inspection scheduling	0	0	3,312	4,259	4,989	5,521	5,983	6,324	6,625	6,880	7,098	6,758	6,459	6,196	5,963	5,753	5,565	5,395	5,240	5,098	103,377	37,580
Total State Benefits	0	0	52,962	67,747	79,937	130,445	139,818	148,409	156,453	204,114	211,513	209,797	208,632	207,937	207,649	207,720	248,112	248,796	248,663	248,770	3,227,474	1,017,919
Benefits - Costs	(122,970)	(29,050)	25,329	41,126	54,075	105,173	115,018	123,995	132,361	89,731	187,927	186,414	185,428	184,887	184,738	184,933	225,437	226,222	226,182	226,373	2,553,325	679,915
Benefit/Cost Ratio	0.00	0.00	1.92	2.54	3.09	5.16	5.64	6.08	6.49	1.78	8.97	8.97	8.99	9.02	9.06	9.12	10.94	11.02	11.06	11.11	4.79	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,618
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,696
Annual Costs:																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Total Carrier Costs	6,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	4,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	32,300	16,113
Carrier Benefits (value per 100 trucks)																						
Time savings at weighstations	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	1,986,400	645,567
One-stop shopping	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	80,000	34,054
Fleet Management	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Total Carrier Benefits	116,653	119,987	123,320	126,653	129,987	133,320	136,653	139,987	143,320	146,653	149,987	153,320	153,320	153,320	153,320	153,320	153,320	153,320	153,320	153,320	2,846,400	1,155,135
Benefits - Costs	110,303	118,787	122,120	125,453	128,787	132,120	135,453	138,787	142,120	142,303	148,787	152,120	152,120	152,120	152,120	152,120	152,120	152,120	152,120	152,120	2,814,100	1,139,022
Benefits/Costs Ratio	18.37	99.99	102.77	105.54	108.32	111.10	113.88	118.66	119.43	33.71	124.99	127.77	127.77	127.77	127.77	127.77	127.77	127.77	127.77	127.77	88.12	

Type VIII: Weighstation with WIM and A VI in ramp, with bypass lane, without A VI in bypass/scale lane

Three Crescent sites are installed with this configuration. These sites are Woodburn, Oregon, San Simon, Arizona, and Berino, New Mexico. The Type VIII site configuration, while not providing the security of identifying bypassing vehicles, provides the same benefits to both states and carriers as Type VII sites.

The net benefit to states is $682,930, while the net benefit to carriers is $1,139,072, as determined by the net present value over a 20-year period. The cost-benefit analysis for this site configuration is presented in Table 7-34.

Type IX: Weighstation with WIM and A VI in bypass lane only

The Santa Nella, California weighstation was the only Crescent site equipped with WIM and AVI in the bypass lane only. The equipment configuration at the Santa Nella weighstation was arranged so that all vehicles passed through the bypass lane for pre-sorting and were required to return to the static lane only when identified by the WIM as being potentially overweight. Although the use of slow-speed WIM in the bypass lane allowed the site to weigh vehicles more quickly, the credentials of each of the trucks were not examined.

The Type IX configuration offers benefits to the states of hazardous material tracking, improved collection of mileage-based taxes, reduced operating costs and automated safety inspections. Since the configuration of the Type IX site did not allow for manual inspection of a carrier's credentials, it is assumed that no benefits are derived from automated credentials inspections. The benefits derived by carriers include one-stop shopping and fleet management.

The net benefit to states is $682,930, while the net benefit to carriers is $293,455, as determined by the net present value over a 20-year period. While this site configuration provided a net benefit to both states and carriers, it did not meet one of the primary functions of a weighstation: to inspect vehicle credentials. For this reason, this site configuration is not considered generally advantageous.

The cost-benefit analysis for this site configuration is presented in Table 7-3 5.

Type X: Weighstation with WIM and A VI in ramp, prior to A VI only static scale lane

The Bow Hill weighstation in Washington was the only Crescent site equipped with WIM and AVI in the ramp leading to the static scale lane, and AVI in the static scale lane. The site officers at the Bow Hill weighstation stated that the configuration displayed during the Crescent evaluation was not a completed installation. Presently, the weighstation is waiting for the installation of the bypass lane which will make the configuration more functional. It is assumed that the AVI in the static lane will be extended with an additional antenna, so that both lanes are AVI-equipped. In this scenario, the Bow Hill configuration will become a Type VII site.

Table 7-34 Benefits and Costs of a Type VIII Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	40,000	0	0	0	0	0	0	0	0	40,000	0	0	0	0	0	0	0	0	0	0	80,000	51,785
AVI	12,000	0	0	0	0	0	0	0	0	12,000	0	0	0	0	0	0	0	0	0	0	24,000	15,536
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	15,000	0	0	0	0	0	0	0	0	15,000	0	0	0	0	0	0	0	0	0	0	30,000	19,420
Weighstation Computer System	17,300	0	0	0	0	0	0	0	0	17,300	0	0	0	0	0	0	0	0	0	0	34,600	22,397
Communications	900	0	0	0	0	0	0	0	0	900	0	0	0	0	0	0	0	0	0	0	1,800	1,165
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	89,795	0	0	0	0	0	0	0	0	88,564	0	0	0	0	0	0	0	0	0	0	178,358	115,777
Annual Costs:																						
Operating Costs																						
Equipment & Communications	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	10,000	4,257
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	400,000	170,271
Total Annual Costs	31,125	29,000	27,583	26,571	25,813	25,222	24,750	24,364	24,042	23,769	23,536	23,333	23,156	23,000	22,861	22,737	22,625	22,524	22,432	22,348	490,791	219,212
Total State Costs	120,920	29,000	27,583	26,571	25,813	25,222	24,750	24,364	24,042	112,333	23,536	23,333	23,156	23,000	22,861	22,737	22,625	22,524	22,432	22,348	669,149	334,989
State Benefits: (value per site)																						
Hazardous material tracking	0	0	9,096	9,823	10,529	11,231	11,940	12,664	13,408	14,177	14,974	15,804	16,668	17,570	18,512	19,496	20,530	21,610	21,660	21,754	281,448	92,745
Improved collection of weight/distance taxes	0	0	5,190	6,834	6,164	9,289	10,273	11,157	11,966	12,727	13,446	13,108	12,830	12,603	12,419	12,271	12,154	12,065	11,999	11,956	200,452	69,220
Reduced operating costs	0	0	0	0	0	40,000	40,000	40,000	40,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	120,000	120,000	120,000	120,000	1,200,000	326,667
Automated credentials inspections	0	0	35,363	46,631	56,275	64,404	71,643	78,285	84,451	90,330	95,994	94,128	92,674	91,567	90,755	90,198	89,864	89,726	89,765	89,962	1,442,198	491,667
Automated safety inspection scheduling	0	0	3,312	4,259	4,969	5,521	5,983	6,324	6,625	6,860	7,098	6,758	6,459	6,196	5,983	5,753	5,585	5,395	5,240	5,098	103,377	37,580
Total State Benefits	0	0	52,962	67,747	79,937	130,445	139,818	148,409	156,453	204,114	211,513	209,797	208,632	207,937	207,649	207,720	248,112	248,798	248,663	248,770	3,227,474	1,017,919
Benefits - Costs	(120,920)	(29,000)	25,379	41,176	54,125	105,223	115,068	124,045	132,411	91,781	187,977	186,464	185,476	184,937	184,788	184,983	225,487	226,272	226,232	226,423	2,558,325	682,930
Benefit/Cost Ratio	0.00	0.00	1.92	2.55	3.10	5.17	5.65	6.09	6.51	1.82	8.99	8.99	9.01	9.04	9.08	9.14	10.97	11.05	11.09	11.13	4.82	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,618
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,696
Annual Costs:																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Total Carrier Costs	6,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	4,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	32,300	16,113
Carrier Benefits (value per 100 trucks)																						
Time savings at weighstations	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	99,320	1,986,400	645,567
One-stop shopping	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	80,000	34,054
Fleet Management	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Total Carrier Benefits	116,653	119,987	123,320	126,653	129,987	133,320	136,653	139,987	143,320	146,653	149,987	153,320	153,320	153,320	153,320	153,320	153,320	153,320	153,320	153,320	2,846,400	1,155,135
Benefits - Costs	110,303	118,787	122,120	125,453	128,787	132,120	135,453	138,787	142,120	142,303	148,787	152,120	152,120	152,120	152,120	152,120	152,120	152,120	152,120	152,120	2,814,100	1,139,022
Benefits/Costs Ratio	18.37	99.99	102.77	105.54	108.32	111.10	113.88	116.66	119.43	33.71	124.99	127.77	127.77	127.77	127.77	127.77	127.77	127.77	127.77	127.77	88.12	

Table 7-35 Benefits and Costs of a Type IX Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	40,000	0	0	0	0	0	0	0	0	40,000	0	0	0	0	0	0	0	0	0	0	80,000	51,785
AVI	12,000	0	0	0	0	0	0	0	0	12,000	0	0	0	0	0	0	0	0	0	0	24,000	15,536
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	15,000	0	0	0	0	0	0	0	0	15,000	0	0	0	0	0	0	0	0	0	0	30,000	19,420
Weighstation Computer System	17,300	0	0	0	0	0	0	0	0	17,300	0	0	0	0	0	0	0	0	0	0	34,600	22,397
Communications	900	0	0	0	0	0	0	0	0	900	0	0	0	0	0	0	0	0	0	0	1,800	1,165
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	89,795	0	0	0	0	0	0	0	0	88,564	0	0	0	0	0	0	0	0	0	0	178,358	115,777
Annual Costs:																						
Operating Costs																						
Equipment & Communications	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	10,000	4,257
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	400,000	170,271
Total Annual Costs	31,125	29,000	27,583	26,571	25,813	25,222	24,750	24,364	24,042	23,769	23,536	23,333	23,156	23,000	22,861	22,737	22,625	22,524	22,432	22,348	490,791	219,212
Total State Costs	120,920	29,000	27,583	26,571	25,813	25,222	24,750	24,364	24,042	112,333	23,536	23,333	23,156	23,000	22,861	22,737	22,625	22,524	22,432	22,348	669,149	334,989
State Benefits: (value per site)																						
Hazardous material tracking	0	0	9,098	9,823	10,529	11,231	11,940	12,664	13,408	14,177	14,974	15,804	16,668	17,570	18,512	19,498	20,530	21,610	21,660	21,754	281,448	92,745
Improved collection of weight/distance taxes	0	0	5,190	6,834	8,164	9,289	10,273	11,157	11,968	12,727	13,446	13,108	12,830	12,603	12,419	12,271	12,154	12,065	11,999	11,956	200,452	69,220
Reduced operating costs	0	0	0	0	0	40,000	40,000	40,000	40,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	120,000	120,000	120,000	120,000	1,200,000	326,687
Automated safety inspection scheduling	0	0	3,312	4,259	4,969	5,521	5,963	6,324	6,625	6,880	7,098	6,758	6,459	6,198	5,963	5,753	5,565	5,395	5,240	5,098	103,377	37,580
Total State Benefits	0	0	17,599	20,916	23,662	66,041	88,175	70,144	72,001	113,784	115,518	115,869	115,956	116,369	116,894	117,522	158,249	159,070	158,899	158,808	1,785,277	526,232
Benefits - Costs	(120,920)	(29,000)	(9,985)	(5,656)	(2,151)	40,819	43,425	45,781	47,960	1,451	91,983	92,336	92,801	93,369	94,032	94,785	135,624	136,546	136,467	136,460	1,116,128	191,243
Benefit/Cost Ratio	0.00	0.00	0.64	0.79	0.92	2.62	2.75	2.88	2.99	1.01	4.91	4.96	5.01	5.06	5.11	5.17	6.99	7.06	7.08	7.11	2.67	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,618
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,696
Annual Costs.																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Total Carrier Costs	6,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	4,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	32,300	16,113
Carrier Benefits (value per 100 trucks)																						
One-stop shopping	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	80,000	34,054
Fleet Management	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,614
Total Carrier Benefits	17,333	20,667	24,000	27,333	30,667	34,000	37,333	40,667	44,000	47,333	50,667	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	860,000	309,668
Benefits - Costs	10,983	19,467	22,800	26,133	29,467	32,800	36,133	39,467	42,800	42,983	49,467	52,800	52,800	52,800	52,800	52,800	52,800	52,800	52,800	52,800	827,700	293,455
Benefits/Costs Ratio	2.73	17.22	20.00	22.78	25.58	28.33	31.11	33.89	36.67	10.88	42.22	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	26.63	

In evaluating the financial viability of the current configuration, the WIM equipment on the ramp provides no additional benefit to the system. However, the site generates a net benefit to the state of $372,647, as presented in Table 7-36. The benefits derived from this configuration include hazardous material tracking, improved collection of mileage-based taxes, automated credentials inspections and automated safety inspection scheduling. Carriers benefits include one-stop shopping and fleet management. As shown in Table 7-36, carriers derive net benefits over a 20-year period of $293,455.

Type XI: Mainline weight screening

Two of the Crescent sites are configured for mainline weight screening, although neither demonstrated this application. These sites are Ashland, Oregon and Santa Nella, California. The Type XI site configuration offers all of the state weighstation benefits and all but one of the state mainline benefits presented in the previous sections. Since the Type XI site configuration is located near a weighstation, it is assumed that no additional gain is made from mainline weight enforcement. The Type XI site is the only configuration which allows AVI-equipped vehicles to bypass the weighstation on the highway.

The net benefit to states is $1,145,770, while the net benefit to carriers is $984,076, as determined by the net present value over a 20-year period. The cost-benefit analysis for this site configuration is presented in Table 7-37.

Table 7-36 Benefits and Costs of a Type X Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	40,000	0	0	0	0	0	0	0	0	40,000	0	0	0	0	0	0	0	0	0	0	80,000	51,785
AVI	14,000	0	0	0	0	0	0	0	0	14,000	0	0	0	0	0	0	0	0	0	0	28,000	18,125
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weighstation Computer System	17,300	0	0	0	0	0	0	0	0	17,300	0	0	0	0	0	0	0	0	0	0	34,600	22,397
Communications	900	0	0	0	0	0	0	0	0	900	0	0	0	0	0	0	0	0	0	0	1,800	1,165
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	76,795	0	0	0	0	0	0	0	0	75,564	0	0	0	0	0	0	0	0	0	0	152,358	98,946
Annual Costs:																						
Operating Costs																						
Equipment & Communications	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	11,000	4,682
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,684
Maintenance Costs	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	400,000	170,271
Total Annual Costs	31,175	29,050	27,633	26,621	25,863	25,272	24,800	24,414	24,092	23,819	23,586	23,383	23,206	23,050	22,911	22,787	22,675	22,574	22,482	22,398	491,791	219,638
Total State Costs	107,970	29,050	27,633	26,621	25,863	25,272	24,800	24,414	24,092	99,383	23,586	23,383	23,206	23,050	22,911	22,787	22,675	22,574	22,482	22,398	644,149	318,584
State Benefits: (value per site)																						
Hazardous material tracking	0	0	9,096	9,823	10,529	11,231	11,940	12,664	13,408	14,177	14,974	15,804	16,668	17,570	18,512	19,498	20,530	21,610	21,660	21,754	281,448	92,745
Improved collection of weight/distance taxes	0	0	5,190	6,834	8,164	9,289	10,273	11,157	11,988	12,727	13,448	13,108	12,830	12,603	12,419	12,271	12,154	12,065	11,999	11,956	200,452	69,220
Automated credentials inspections	0	0	35,363	46,831	56,275	64,404	71,643	78,265	84,451	90,330	95,994	94,128	92,674	91,587	90,755	90,198	89,864	89,726	89,765	89,962	1,442,198	491,667
Automated safety inspection scheduling	0	0	3,312	4,259	4,969	5,521	5,983	6,324	6,625	6,880	7,098	6,758	6,459	6,198	5,983	5,753	5,565	5,395	5,240	5,098	103,377	37,580
Total State Benefits	0	0	52,962	67,747	79,937	90,445	99,818	108,409	116,453	124,114	131,513	129,797	128,632	127,937	127,849	127,720	128,112	128,798	128,663	128,770	2,027,474	691,232
Benefits - Costs	(107,970)	(29,050)	25,329	41,126	54,075	65,173	75,018	83,995	92,361	24,731	107,927	106,414	105,426	104,887	104,738	104,933	105,437	106,222	106,182	106,373	1,383,325	372,647
Benefit/Cost Ratio	0.00	0.00	1.92	2.54	3.09	3.58	4.02	4.44	4.83	1.25	5.58	5.55	5.54	5.55	5.57	5.60	5.65	5.71	5.72	5.75	3.15	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,816
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,896
Annual Costs:																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Total Carrier Costs	6,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	4,350	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	32,300	16,113
Carrier Benefits (value per 100 trucks)																						
One-stop shopping	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	80,000	34,054
Fleet Management	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Total Carrier Benefits	17,333	20,667	24,000	27,333	30,667	34,000	37,333	40,667	44,000	47,333	50,667	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	860,000	309,568
Benefits - Costs	10,983	19,467	22,800	26,133	29,467	32,800	36,133	39,467	42,800	42,983	49,467	52,800	52,800	52,800	52,800	52,800	52,800	52,800	52,800	52,800	827,700	293,455
Benefits/Costs Ratio	2.73	17.22	20.00	22.78	25.56	28.33	31.11	33.89	36.67	10.88	42.22	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	26.83	

Table 7-37 Benefits and Costs of a Type XI Configuration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL	Net Present Value
Total Number of HELP sites	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460		
State Costs																						
Initial Costs:																						
Capital and Installation																						
WIM/AVC	80,000	0	0	0	0	0	0	0	0	80,000	0	0	0	0	0	0	0	0	0	0	160,000	103,571
AVI	14,000	0	0	0	0	0	0	0	0	14,000	0	0	0	0	0	0	0	0	0	0	28,000	18,125
State Computer Terminal	95	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	189	123
Lane Signal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weighstation Computer System	17,300	0	0	0	0	0	0	0	0	17,300	0	0	0	0	0	0	0	0	0	0	34,600	22,397
Communications	900	0	0	0	0	0	0	0	0	900	0	0	0	0	0	0	0	0	0	0	1,800	1,165
Regional/State Computer System	4,500	0	0	0	0	0	0	0	0	3,269	0	0	0	0	0	0	0	0	0	0	7,769	5,351
Total Initial Costs	116,795	0	0	0	0	0	0	0	0	115,564	0	0	0	0	0	0	0	0	0	0	232,358	150,732
Annual Costs:																						
Operating Costs																						
Equipment & Communications	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	100,000	42,588
Crescent Management	10,625	8,500	7,083	6,071	5,313	4,722	4,250	3,864	3,542	3,269	3,036	2,833	2,656	2,500	2,361	2,237	2,125	2,024	1,932	1,848	80,791	44,664
Maintenance Costs	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	500,000	212,839
Total Annual Costs	40,625	38,500	37,083	36,071	35,313	34,722	34,250	33,864	33,542	33,269	33,036	32,833	32,656	32,500	32,361	32,237	32,125	32,024	31,932	31,848	680,791	300,091
Total State Costs	157,420	38,500	37,083	36,071	35,313	34,722	34,250	33,864	33,542	148,833	33,036	32,833	32,656	32,500	32,361	32,237	32,125	32,024	31,932	31,848	913,149	450,823
State Benefits: (value per site)																						
Data Collection	55,373	57,034	58,745	60,508	62,323	64,192	66,118	68,102	70,145	72,249	74,417	76,649	78,949	81,317	83,757	86,269	88,857	91,523	94,269	97,097	1,487,893	578,674
Hazardous material tracking	0	0	9,098	9,823	10,529	11,231	11,940	12,664	13,408	14,177	14,974	15,804	16,668	17,570	18,512	19,498	20,530	21,610	21,660	21,754	281,448	92,745
Improved collection of weight/distance taxes	0	0	5,190	6,834	8,164	9,269	10,273	11,157	11,968	12,727	13,446	13,108	12,830	12,603	12,419	12,271	12,154	12,065	11,999	11,956	200,452	69,220
Reduced operating costs	0	0	0	0	0	40,000	40,000	40,000	40,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	120,000	120,000	120,000	120,000	1,200,000	326,687
Automated credentials inspections	0	0	35,383	46,831	56,275	64,404	71,643	78,285	84,451	90,330	95,994	94,126	92,674	91,567	90,755	90,198	89,864	89,726	89,765	89,962	1,442,198	491,667
Automated safety inspection scheduling	0	0	3,312	4,259	4,969	5,521	5,963	6,324	6,625	6,880	7,098	6,758	6,459	6,196	5,963	5,753	5,565	5,395	5,240	5,098	103,377	37,580
Total State Benefits	55,373	57,034	111,707	128,255	142,260	194,637	205,937	216,511	226,597	276,363	285,929	286,446	287,581	289,254	291,408	293,989	336,970	340,319	342,932	345,867	4,715,368	1,596,593
Benefits - Costs	(102,047)	18,534	74,624	92,183	106,948	159,915	171,687	182,647	193,056	127,530	252,894	253,613	254,924	256,754	259,044	261,753	304,845	308,295	311,000	314,018	3,802,219	1,145,770
Benefit/Cost Ratio	0.35	1.48	3.01	3.56	4.03	5.61	6.01	6.39	6.76	1.86	8.66	8.72	8.81	8.90	9.00	9.12	10.49	10.63	10.74	10.86	5.16	
Carrier Costs																						
Initial Costs:																						
Capital and Installation																						
AVI Transponders	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,000	1,618
Computer Hardware/Software	3,000	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	0	6,000	3,884
Communications	150	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	300	194
Total Initial Costs	5,150	0	0	0	0	0	0	0	0	3,150	0	0	0	0	0	0	0	0	0	0	8,300	5,696
Annual Costs.																						
Operating Costs																						
Equipment and Communications	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	24,000	10,216
Users Fee	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	1,040,000	442,705
Maintenance Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Annual Costs	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	1,064,000	452,922
Total Carrier Costs	58,350	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	56,350	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	53,200	1,072,300	458,618
Carrier Benefits (value per 100 trucks)																						
Time savings at weighstations	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	133,120	2,662,400	1,133,326
One-stop shopping	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	80,000	34,054
Fleet Management	13,333	16,667	20,000	23,333	26,667	30,000	33,333	36,667	40,000	43,333	46,667	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	780,000	275,514
Total Carrier Benefits	150,453	153,787	157,120	160,453	163,787	167,120	170,453	173,787	177,120	180,453	183,787	187,120	187,120	187,120	187,120	187,120	187,120	187,120	187,120	187,120	3,522,400	1,442,893
Benefits - Costs	92,103	100,587	103,920	107,253	110,587	113,920	117,253	120,587	123,920	124,103	130,587	133,920	133,920	133,920	133,920	133,920	133,920	133,920	133,920	133,920	2,450,100	984,076
Benefits/Costs Ratio	2.58	2.89	2.95	3.02	3.08	3.14	3.20	3.27	3.33	3.20	3.45	3.52	3.52	3.52	3.52	3.52	3.52	3.52	3.52	3.52	3.28	